(28,719)

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1922.

No. 273.

GEORGE E. VANDENBURGH, PETITIONER,

vs.

TRUSCON STEEL COMPANY.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SIXTH CIRCUIT.

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UNITED STATES OF AMERICA

Northern District of Ohio

Eastern Division.

Record of the proceedings of the District Court of the United States within and for the Eastern Division of the Northern District of Ohio, in the cause and matter hereinafter stated, the same being finally disposed of at a regular term of said court begun and held at the City of Cleveland, in said District, on the first Tuesday in October being the 5th day of said month in the year of our Lord One Thousand Nine Hundred and Twenty, and of the Independence of the United States of America, the One Hundred and forty-fifth to wit: on Monday the 18th day of October, A. D. 1920. Present: Honorable D. C. Westenhaver, United States District Judge.

George E. Vandenburgh)
vs.)
Turscon Steel Company, a corporation)

No. 500. Equity.

Said action was commenced on the 18th day of September, A. D. 1919, and proceeded to final disposition at the term and day above written, and during the progress thereof, pleadings and papers were filed, process was issued and returned and orderes

of the Court were made and entered in the order and on the dates hereinafter stated, to wit:

Complaint filed	Sept. 18, 1919
Answer filed	Oct. 1, 1919
Trial	June 8, 1920
Order dismissing bill entered	Oct. 18, 1920
Appeal petition filed	Nov. 5, 1920
Assignment of errors filed	Nov. 5, 1920
Order fixing bond entered	Nov. 6, 1920
Bond filed and citation issued	Dec. 2, 1920
Stipulation filed as to contents of record	Dec. 17, 1920
Stipulation filed under Sec. 7, Rule 44	Dec. 28, 1920

IN THE EASTERN DIVISION OF THE UNITED STATES DISTRICT COURT IN AND FOR THE NORTHERN DISTRICT OF THE STATE OF OHIO.

BILL OF COMPLAINT.
In Equity No. 500.

GEORGE E. VANDENBURGH,)
Complainant,)
vs.)
TRUSCON STEEL CO., a corporation,)
Defendant.)

BILL OF COMPLAINT IN EQUITY.

GEORGE E. VANDENBURG, a citizen of the United States, and a resident of the city and county of San Francisco, state of California, brings this his bill of complaint against the TRUSCON STEEL Company, a corporation duly organized and existing under the laws of the state of Ohio and having a place of business at Youngstown in the state of Ohio, and for cause of action alleges and avers:

1. That heretofore; to-wit, on and prior to May 9th, 1906 your orator was the original, first and sole inventor of a certain new and useful reinforcing bar particularly adapted for cement and concrete construction, more fully described in the reissue patent hereafter referred to and made a part hereof.

II. That said invention was new and useful, not known or used by others in this country, and not

patented or described in any printed publication in this or any foreign country before the invention thereof bysaid George E. Vandenburgh or more than two years prior to May, 1906, and not in public use or on sale in the United States for more than two years prior to May 9th, 1906, and not abandoned by your orator.

III. That your orator did, on the aforesaid ninth day of May 1906, duly and regularly make and file an application for patent on said invention in the United States Patent Office at Washington D. C. praying the grant to him of a patent for said invention.

IV. That thereafter upon due and regular proceedings had by the Patent Office in the matter of said Patent Application on the twenty second day of January 1907, letters patent number 841,741 were regularly granted and delivered by the United States Government to your orator, his heirs and assigns wherein and whereby there was secured to your orator his heirs and assigns for the full term of seventeen years from the 22nd day of January 1907, the sole and exclusive right to make, use and vend said invention throughout the United States of America and its territories.

V. That said letters patent were issued in due form of law under the seal of the Patent Office of the United States, and were duly signed by the Commissioner of Patents, or by his Assistant acting for him, and prior to the grant thereof all proceedings were had which were then required by the law to be taken prior to the grant of letters patent for new

and useful inventions, and were thereafter delivered to your orator.

VI. That thereafter it appeared to your orator that said letters patent were defective and insufficient by reason of the fact that your orator had claimed more than he had a right to claim as new, and by reason of the fact that the verbiage of the claims was defective in not precisely corresponding with the terms of the Specifications whereupon on, to-wit July 1st, 1916, being then sole owner of all right, title and interest in said patent, your orator prepared in accordance with law and filed an application with the Commissioner of Patents of the United States to have said Patent reissued; that thereafter due proceedings were had by the United States Patent Office, and in regular course said Patent was reissued and was delivered to your orator granting to him rights of the same effect and operation in law as if the same had been originally filed in such corrected form, and that the errors or mistakes in the original Patent arose by accident or inadvertence and without fraudulent or deceptive intention on the part of your orator.

VII. That said reissued letters patent were granted in due form of law under the seal of the United States Patent Office, and were signed by the Acting Commissioner of Patents, and bear date of August 15, 1916, under the number 14182, and that all requisite proceedings were had prior to the reissuance of said letters patent which are required by law in such cases, and profert is hereby made of said reissued letters patent, or a certified copy there-

of, for a more complete and full description of the invention covered thereby; and that your orator is now the sole owner of all right, title and interest in said reissued letters patent.

VIII. That said invention as protected by said patent and said reissue thereof, is of great and increasing value and utility and the public generally has acquiesced in the validity of said letters patent and the reissue thereof; that your orator has practised said invention and has marked his concrete reinforcement with the word "Patented" and with the dates of said patent and of said reissue patent; that your orator is desirous of preserving to himself all rights secured to him under said patent and the reissue thereof, that he has a regular and established license fee of 5% to 7½ per centum of the selling price of said reinforcing where he has permitted others to use said invention, and that the U. S. Circuit Court of Appeals at New York, N. Y. has finally decided said patent and reissue thereof to be valid and infringed in the case of Vandenburgh vs. Concrete Steel Co., April 16, 1919.

IX. That well knowing the premises and for the purpose of injuring and damaging your orator and without right or license from him, since the issuance of said letters patent, and since the reissuance thereof, within six years last past the above named defendant has made at Youngstown, Ohio and sold to divers persons and corporations concrete reinforcing containing and embodying the invention disclosed and claimed in the patent and reissued patent aforesaid that said reinforcing is now in use; that de-

fendant has made and sold several thousand tons of said concrete reinforcing for use in thousands of structures covering a large part of the country, a partial list of which structures is as follows:

Y. M. C. A. Building, Youngstown, Ohio (7 stories)

Ohio Hotel, Youngstown, Ohio (designed for 11 stories)

Hippodrome Theatre Building, Youngstown, Ohio.

Stearns Automobile Factory, Cleveland, Ohio.

Service Building for Ford Automobile Co., Columbus, Ohio.

Packard Motor Car Company, Detroit, Mich. (about 20 buildings)

Detroit Athletic Club, Detroit, Mich. (Finest structure ever built of its kind.)

Palmer Building, Detroit, Mich. (Eight stories)

Ford Service Building, Detroit, Mich. (Eight stories)

Ford Motor Car Co. Factory Bldgs. (800′ x 60′ per floor)

International Harvester Co. Buildings Chicago, Ill. (Deering Plant) (Very heavy live loads)

Packard Service Building, Chicago, Ill.

Booth Cold Storage Building, Detroit, Mich.

Sommers Store Building, Indianapolis, Ind.

Y. M. C. A. Building, Cincinnati, Ohio.

Schenley Farms Warehouse, Pittsburg, Pa. (Very heavy live loads, 8 stories).

Pierce Automobile Co. Buildings, Buffalo, N. Y.

Dalley Building, Buffalo, N. Y.

Ford Service Building, Pittsburg, Pa.

Standard Automobile Co. Building, Pittsburg, Pa.

Packard Service Building, Pittsburg, Pa.

Bates Mfg Company, Weave Mill, Lewiston, Maine (400 x 600)

Pevely Dairy Company Building, St. Louis, Mo. (2 bldgs—very heavy loads)

Blish-Mise-Stillman Warehouse, Atcheson, Kansas.

Automobile Club of America, New York City.

Packard Service Building, New York City.

Morgenthaler Linotype Buildings, Brooklyn, N. Y.

Murphy Hotel, Richmond, Va.

Hicks Hotel, Savannah, Georgia.

McDermott Church, New Orleans, La. (Hooped columns supporting church tower.)

Campbell Building, Oklahoma City, Okla. (11 stories.)

Presidential Palace, Havana - Cuba, (Hooped columns supporting large dome.)

Portland Light Heat & Power Co. Buildings, Portland, Oregon;

and that said defendant notwithstanding notice by registered mail of such infringement threatens to continue the same, and does now continue such infringement of the rights secured to your orator as set forth and disclosed in the patent and reissue patent aforesaid.

X. Your orator further shows unto your Honors that he has notified said defendant by registered letter to desist from such infringement of his rights in the premises, but notwithstanding such notice

the said defendant has utterly refused and neglected to discontinue the manufacture and sale of said concrete reinforcing and threatens to continue the making, using and selling of said concrete reinforcing bars embodying the invention herein referred to, and your orator further avers that such infringement of his rights by the defendant will work an irreparable damage, loss and injury to your orator unless restrained by the order of this Honorable Court.

XI. Your orator further avers that by reason of such infringement defendant has made large gains and profits and your orator has suffered and sustained injuries and damages in a large amount, the total of which cannot be ascertained without the taking of an account and the amount of which is at present unknown to your orator.

XII. That your orator has no plain speedy or adequate remedy at law and can be relieved only in a Court of Equity where matters of that nature are cognizable.

WHEREFORE YOUR ORATOR PRAYS:

That defendant be required to answer, an Oath thereupon being expressly waived, to the best and utmost of his knowledge fully, perfectly and truly, all and singular, the things charged in the aforesaid Bill of Complaint; that said defendant, his or their several agents, employees, servants, attorneys, workmen and others acting for him, be enjoined and restrained from infringing said Letters Patent and the

Reissue thereof; that said defendant be ordered to account for and pay over to your orator the gains and profits which he has made and realized, and in addition to said actual damages sustained by your Orator because of said infringement, that the amount thereof be increased three times as provided by the law in such cases made and provided because of the wilful nature of said infringement; that to ascertain the amount of such manufacture and sales a master be appointed; and that plaintiff have his costs of this action.

May it please your Honors to grant unto your Orator a writ of injunction issued out of and under the seal of this Honorable Court, pendente lite and until final hearing, enjoining and restraining said defendant, his or their several agents, attorneys, employees, servants, workmen and others acting for him, from making, selling or using, or causing to be made, sold or used, any concrete reinforcing bars with spirally disposed coils secured thereto as set forth in said patent No. 841,741 and reissue patent No. 14,182, and that upon final hearing of this case that said injunction be made perpetual, and that your Orator have such other further and additional relief as shall seem meet in equity and good conscience.

Wherefore may it please your Honors to grant unto your Orator a Writ of Subpoena ad Respondendum directed to the Defendant, Truscon Steel Company, commanding it or him by a day certain, and under a certain penalty, to be and appear in this Honorable Court and to then and there answer

this Bill of Complaint, and to abide by such order and decree as your Honors shall then make.

GEORGE E. VANDENBURGH,
Complainant.

CARLOS P. GRIFFIN,
Counsel for Complainant.

WM. R. MILLER,
Solicitor for Complainant.

STATE OF CALIFORNIA,
City and County of San Francisco,—ss.

CARLOS P. GRIFFIN, being duly sworn, deposes and says: that he is the attorney of record for George E. Vandenburgh, the complainant herein and is familiar with the matters recited in the above entitled action; that he has read the foregoing complaint and knows the contents thereof, that the same is true of his own knowledge, except as to the matters which are therein recited on his information or belief, and as to those matters that he believes it to be true, and that George E. Vandenburgh is in Virginia and not available for the purpose of signing this complaint at the present time.

CARLOS P. GRIFFIN.

Subscribed and sworn to before me this 19th day of August A. D. 1919.

HENRY B. LISTER,
Notary Public in and for the City and County of San Francisco, State of California.

(Notarial Seal)

Filed: Sep 18 1919 B. C. Miller, Clerk, U. S. District Court, N. D. O.

[TITLE OF COURT AND CAUSE.]

ANSWER.

FIRST: The defendant admits the citizenship and corporate organization of the parties as alleged.

SECOND: The defendant has no knowledge as to the allegations of the first numbered paragraph of the bill of complaint and therefore denies the same and leaves the plaintiff to his proofs.

THIRD: Defendant has no knowledge as to the allegations of the second numbered paragraph of the bill of complaint except as to prior knowledge, use, sale, patenting and description, and thereupon denies the same and leaves the plaintiff to his proof, but specially denies that such invention was new, useful, and not known, used, patented or described more than two years prior to May, 1906, and avers that same was old, inutile, known, used, patented and described as hereinafter set forth.

FOURTH: Defendant admits the allegations of the third numbered paragraph of the bill of complaint.

FIFTH: Defendant admits that part of the fourth numbered allegation of the bill of complaint averring the application for and issuance of the patent, but denies that such proceedings were regular or secured any rights to the plaintiff as claimed by the plaintiff herein.

SIXTH: Defendant admits the allegations of the fifth numbered paragraph of the bill of complaint.

SEVENTH: Defendant specially denies that part of the sixth numbered paragraph of the bill of com-

plaint in which it is averred that it appeared to the plaintiff or was true in fact that said Letters Patent were defective and insufficient by reason of the fact that the plaintiff claimed more than he had a right to claim as new and by reason of the fact that the verbiage of the claims was defective in not precisely corresponding with the terms of the specifications and denies that by the reissue and delivery of said patent the plaintiff was granted rights of the same effect and operation in law as if the same had been originally filed in such corrected form and that any errors or mistakes in the original patent arose by accident or inadvertence and without fraudulent or deceptive intention on the part of the plaintiff, and otherwise admits the allegations of said paragraph.

EIGHTH: Defendant denies the allegations of the seventh numbered paragraph of the bill of complaint to the effect that all requisite proceedings were had prior to the reissuance of said Letters Patent which were required by law in such case; and otherwise admits the allegations of said paragraph.

NINTH: The defendant has no knowledge as to the allegations in the eighth numbered paragraph of the bill of complaint except as hereinafter stated and thereupon denies the same and leaves the plaintiff to his proofs in such respect; but defendant says that such decision of the United States Circuit Court of Appeals was rendered upon an inadequate, incomplete and insufficient presentation of the matters and things involved in the question of the validity of such patent and reissue as hereinafter presented herein.

TENTH: Defendant admits that within six years last past it has made at Youngstown, Ohio, and sold to divers persons and corporations several thousand tons of concrete reinforcing for use in many structures covering a large part of the country, a partial list of which is given in the ninth numbered paragraph of the bill of complaint; but denies that same was done for the purpose of injuring and damaging the plaintiff or to the injury or damage of the plaintiff by reason of the plaintiff's patent claims or otherwise. Defendant admits that recently, within such six years, it has had notice by registered mail that plaintiff claims infringement but denies that it has infringed any valid patent claims of the plaintiff.

ELEVENTH: Defendant admits the allegations of the tenth numbered paragraph of the bill of complaint that it has been notified by plaintiff by registered mail to desist from infringement of plaintiff's rights and has refused to discontinue the manufacture and sale of concrete reinforcing and expects to continue to make, use and sell all its various types of concrete reinforcing, but denies that such manufacture, sale and use embodies any invention or valid patent rights of the plaintiff or infringement of same and will work damage, loss and injury, irreparable or otherwise, to the plaintiff.

TWELFTH: Defendant denies the allegations of the eleventh numbered paragraph of the bill of complaint.

THIRTEENTH: Defendant admits the allega-

tions of the twelfth numbered paragraph of the bill of complaint.

FOURTEENTH: Defendant further answering, upon information and belief says and charges the fact to be that said original patent No. 841,741 and reissue patent No. 14,182 are void and of no effect in law for the folowing reasons:

(a) That for the purpose of deceiving the public the descriptions and specifications filed by the patentee were made to contain less than the whole truth relative to the inventions or discoveries or more than was or is necessary to produce the desired effect.

(b) That while the application for said Letters Patent was pending in the United States Patent Office, the applicant for said patent so limited the scope and confined the claims of his application under the requirement of the Commissioner of Patents that the plaintiff cannot now ask for and is not entitled to insist upon or obtain construction of the claims of said patent sufficiently broad to include or cover any construction or device embodied in or used by defendant.

(c) That the things patented in said Letters Patent numbered 841,741 and 14,182 had been patented and described in printed publications in the United States and elsewhere prior to the supposed invention and discovery of said patent and more than two years prior to plaintiffs original application for Letters Patent in the following United States Letters Patents:

[Amendment made by leave of Court this 9th day of June, 1920. B. C. Miller, Clerk.]

Weinig, #168,948 1875
Phelps, #175,155 1876
Bauman, #212,645, 1879
Carson, #278,220, 1883,
Monier, #302,664, 1884,
Randall #349,603, 1886,
Harmon & McNutt #380,627 1888,
Salisch #417,397 1889,
Stempel #411,360 1889
Miles, #429,935 1890
Bond, #432,930 1890
Prescott, #447,162, 1891
Stempel, #468,269 1892,
Brinkman 530,064 1894
Norwood, 571,575 1896
Clark, #589,593, 1897,
Johnson #589,898, 1897,
McCall, #657,827, 1900,
Martin, #674,538, 1901
Caldwell, #682,316, 1901
Villet, #722,417 1903
Eason, #723,657 1903
Kahn, #736,602, 1903
Considere, #752,523, 1904,
Carey, #756,471 1904,
Cummings, #764,883, 1904,
Pohlman, #766,899 1904,
Kahn, #768,284 1904,
Gardner, #785,417 1905,
Peabody, #805,663 1905,

Golding, #815,157 1906
Cummings, #815,409 1906
Muesser, #815,617 1906
Cumings, #822,587 1906
Cummings, #828,931, 1906.
In the following British Letters Patent:
Hyatt, No. 1715, of 1874.
Lee and Hodgson, No. 14,559 of 1885.
Banks, No. 12,228 of 1893.
Dumas, No. 20,675 of 1902.
Wells, No. 12625 of 1904.
Coignet, No. 24,371 of 1904.
In the following German Patent:
Kieserling & Moller, No. 73,004 of 1892.
In the following French Patent:
Pellegrin, No. 323,457 of 1902.
In the following Swiss Patents:
Munch, No. 19,279 of 1900.
Mollins, No. 29,781 of 1903.

and in publications as follows:

"Le Beton Arme" by Paul Christophe, published in France about 1900 and in the United States in 1902.

The Engineering News, published in this country, article by Charles H. Marquess, "Design for a Reinforced Concrete Column Without Patented Features" about August 18, 1904; for March, 1906 showing columns for Hotel at Atlantic City, N. J.; for June 23, 1904, showing design for Reinforced Concrete Bins for Grain Elevators; for June 15, 1905 "Result of Comparative Tests of Plain and Reinforced Concrete Columns".

Articles by Armand Considere, published in France and Germany, a communication to the French Academy of Science about 1900, on the effect of hooping on concrete, "Gene Civil" and "Beton und Eisen" about 1902, translated in part into English and published by McGraw Publishing Co. in New York in 1903 under title "Experimental Researches on Reinforced Concrete", besides other patents and printed publications which are at present unknown to this defendant, but which it craves leave, when ascertained, to insert in this answer by amendment, with the same force and effect as though the same had been originally included.

(d) That plaintiff was not the original and first inventor or discoverer of any material or substantial part of the things patented in said Letters Patents, Nos. 841,741 and 14,182, and that the various patentees and assignees and other persons mentioned in patents and publications listed in paragraph (c) hereinbefore had knowledge and made use of and there was in public use and on sale in the U. S. and elsewhere the things alleged to be patented by plaintiff and of every material and substantial part thereof or the equivalents thereof prior to the alleged invention specified in the bill of complaint and more than two years prior to plaintiff's original application at places mentioned in said patents and elsewhere in this country and that knowledge and use of the things alleged to be patented and of every material and substantial part thereof had been known to, and made and publicly used, prior to the alleged invention specified in the bill of complaint,

by Frederick P. Smith, 58 West Lake Street, Chicago, Illinois, Edward McClure, 109 East Lake Street, Chicago, Illinois, and by Robert A. Cummings at Hampton, Virginia, in 1903; at Richmond, Va., about March, 1904; at New York, N. Y.; Pittsburgh, Pa.; and Dennison, Ohio, about 1905 and 1906; by Julius Kahn at Atlantic City, N. J., in January, February and March, 1906 and for several months prior thereto at the places hereinbefore mentioned and elsewhere in this country, besides many other persons whose names and addresses are at present unknown, but which defendant craves leave to insert in this answer as soon as ascertained with the same force and effect as though the same had been originally pleaded herein.

(e) That the things described and claimed in the said Letters Patent had been on sale and in public use in the United States for more than two years before the application for said Letters Patent and that the persons hereinbefore named as having had prior knowledge and use of the alleged invention, and many others, knew of said public use and sale.

(f) That it appears from matters appearing upon the face of said patent sued upon and from various well known facts of common knowledge of which the court will take judicial notice, that the claims of the said patent are invalid and void.

(g) That the invention claimed in the patent in suit is substantially different from any indicated, suggested, or described in the original application therefor.

(h) That the description of the invention in the

specifications of the patent in suit is not in such full, clear, concise and exact terms as to describe and support the alleged invention covered by the claims and justify the allowance thereof.

(i) That the Commissioner of Patents exceeded his legal authority in issuing and was without jurisdiction to issue the patent in suit.

(j) That the description of the invention in the specification of the patent in suit is not in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains or with which it is most nearly connected, to make, construct, compound and use the same.

FIFTEENTH: That the plaintiff during the time his application for such patent and the reissue thereof was pending in the Patent Office and in the course of the pursuance of such application, and to induce the Patent Office and the officers thereof to allow and issue such patent as the same was allowed and issued, stated and represented to the Patent Office and the officers thereof in substance and effect that his application claim did not pertain to the use of devices such as are used by the defendant in the manufacture and sale of concrete reinforcing and thereby procured the issuance of the patent in suit in the manner and for as issued and is thereby estopped to contend that the manufacture of the defendant infringe the patent in suit and has thereby waived any rights or claims in respect thereto.

SIXTEENTH: That the plaintiff during the time his application for such patent and the reissue thereof was pending in the Patent Office and in the course

of the pursuance of such application, and to induce the Patent Office and the officers thereof to allow and issue such patent as the same was allowed and issued, stated and represented to the Patent Office and the officers thereof in substance and effect that his application and claim did not pertain to the use of devices such as are used by the defendant in the manufacture and sale of concrete reinforcing, and particularly in respect to the then contention of the plaintiff, that his coils of reinforcement were rigidly affixed in the kerfs of his bar for the purpose of establishing, securing and making as a part of his invention a truss action in concrete in respect to a bar reinforcing concrete, as distinguished from columner enclosure of concrete, through the truss action between said bar and said coils rigidly affixed thereto, and thereby procured the issuance of the patent in suit in the manner and form as issued and is thereby estopped to contend that the manufactures of the defendant infringe the patent in suit and has thereby waived any rights or claims in respect thereto.

SEVENTEENTH: Defendant further avers that said original patent No. 841,741 was a mere paper patent procured to be issued in an effort upon the part of the plaintiff to copy, imitate and provide a patentable substitute for a reinforcing bar in concrete of the type theretofore designed by Julius Kahn and now owned by the defendant as assignee and was inutile and valueless as such, and no effort was made to manufacture and use under the same or to advance the interests of the public by introducing the same into use, and thereafter this defend-

ant and many others engaged in the business of manufacturing and selling columner reinforcement and at large expense for experimental and testing purposes, and for advertising and introducing such columner reinforcement, built up a large and valuable business therein upon the faith of the records of the Patent Office of the United States as then existing and upon the knowledge that the plaintiff had or claimed no patent rights inconsistent therewith or to be infringed thereby; that the conditions as aforesaid existed and continued for about nine years; that thereupon and thereafter the plaintiff conceived that he might procure a reissue of said patent No. 841,741 in such form as to secure to himself the benefits and advantages of the business so built up by the defendant and others as aforesaid throughout the United States and falsely and fraudulently represented to the Patent Office that his said original patent was defective and insufficient by reason of the fact that he had claimed more than he had a right to claim as new and that the verbiage of the claim was defective and not precisely corresponding with the terms of the specifications, and made application for a reissue patent and thereby procured the issuance of the reissue patent No. 14,182 in suit; whereby plaintiff is estopped and precluded to claim infringement of said reissue patent even though otherwise entitled thereto by reason of such intervening right thereto on the part of the defendant and others.

EIGHTEENTH: Defendant makes the averments of the last numbered preceding paragraph part hereof and therefore says that by reason of

the delay and laches of the plaintiff in putting the alleged invention of his original patent into use and in making application for reissue, the plaintiff had abandoned and waived all rights to procure such issue, and particularly against this defendant, and such reissue is void and of no effect.

NINETEENTH: The defendant says that by reason of the broadening of the claims in said reissue patent and because the original patent was not inoperative and invalid because of defective or insufficient specification and by reason of the original patentee not having claimed as his own invention or discovery more than he had a right to claim as new, and thereupon narrowing his claims, there existed no jurisdiction in the Patent Office of the United States to allow and issue such reissue patent.

TWENTIETH: Defendant denies that the structure set forth in said reissue patent No. 14,182 constituted an invention at any date less than two years prior to May 9, 1906.

TWENTY-FIRST: Defendant denies that the plaintiff was the original and first inventor of the inventions claimed in said reissue patent, No. 14,182 or that said patent and the structures described in the specifications alleged to support the same involved the exercise of the inventive faculty and affirmatively avers that the plaintiff was not the original and first inventor and that the structures described and the claims made did not involve the exercise of the inventive faculty or anything more than the mere application of skill in the art in the com-

bination and application of devices well known in the prior art.

TWENTY-SECOND: Defendant further avers that during the prosecution of the application on which matured into Letters Patent 841,741, now canceled, the claims were so restricted that the same do not now cover or include anything made, used or sold by the defendant; that plaintiff's own statements during the prosecution of said application show that he did not intend the claims to include structures like that made by defendant and that such statements and limitations were not changed by the reissue Letters Patent.

TWENTY-THIRD: Defendant further avers that structures were disclosed in patents hereinbefore referred to and publicly used prior to the date of application for said reissue Letters Patent which prevent said reissue letters patent from being construed to cover anything now or heretofore made, used or sold by this defendant.

TWENTY-FOURTH: Defendant says that plaintiff, for the purpose of endeavoring to secure other, further and different rights under said reissue patent, as a consideration therefor, and voluntarily, fully and completely surrendered and caused and permitted to be cancelled said original patent to plaintiff and all rights thereunder except such rights as were secured to plaintiff by said reissue patent as accepted by him, and that plaintiff has no patent rights of any kind or character except under said reissue patent, which defendant says is utterly void

(Testimony of George E. Vandenburgh.)

because of the matters and things hereinbefore set forth.

All of which foregoing denials and averments this defendant is willing and ready to prove as this Court may direct.

WHEREFORE defendant prays to be hence dismissed with its costs in this behalf sustained.

W. F. GUTHRIE,

Solicitors for Truscon Steel Company, Youngstown, Ohio.

E. N. PAGELSEN

Of Counsel.

Filed Oct 1 1919 B C Miller, Clerk, U. S. District Court, N. D. O.

PLAINTIFF'S TESTIMONY.

In the opening statement, plaintiff's attorney stated that the plaintiff was only going to undertake to sustain claims 1 and 3 of the patent in suit, and thereupon called as a witness

GEORGE E. VANDENBURGH,

who, being first duly sworn, stated in answer to questions by Mr. Griffin, that his present residence was 1005 Eighth Street, Washington, D. C., that he was 57 years of age, and that he is the George E. Vandenburgh who brought an action against the Electric Welding Company of Pittsburgh, and the Concrete Steel Company of New York upon this same patent, reissue No. 14182.

That said invention was made in February, 1903.

(Testimony of George E. Vandenburgh.)

Objected to by defendant as stating a conclusion. That said invention was not known or used by others or patented or described in any printed publication prior to his invention thereof to the best of his knowledge; that he made application for patent on said invention May 9, 1906, upon which a patent was regularly granted January 22, 1907; that he is not an expert in patent matters, but is a bricklayer and mechanic; that upon the suggestion of Mr. Carlos P. Griffin on July 1, 1916, he made application to have said patent reissued because there were several mistakes in the wording of some of the claims, and one claim was too broad. It called for any kind of a fastening, whereas he invented the kerf fastening and wanted to limit all claims to his invention. One of the claims also called for the end of the bar instead of the edge. Such mistakes were unintentional and the patent was duly granted on the application. I granted a license to a Chicago concern that put up a building in San Francisco. I threatened suit and they compromised by taking a license and paying one year's royalty. They have since gone out of business. Also, since the decision against the Concrete Steel Company in New York, I have licensed the Corrugated Bar Company of Buffalo, New York.

The validity of Claim 3 has been established, and this is the plaintiff, George E. Vandenburgh, in an action decided on appeal by the Circuit Court of Appeals of the United States for the Third Circuit at Philadelphia, No. 2479, against the Electric Weld-

(Testimony of George E. Vandenburgh.)

ing Company, the opinion being received and filed February 19, 1920, and also the plaintiff in an action brought in the Southern District of New York against the Concrete Steel Company, entitled Equity No. 14-88, and decided on appeal by the Circuit Court for the Second District, April 16, 1919, appeal No. 172. Both of said appeals on patent No. 14182.

It is also stipulated that the opinions in the trial and reviewing court in each of these cases may be considered by the court here on appeal by reference to published copies thereof, typed or uncertified copies, presented by counsel without incorporating the same into the record, and the same stipulation is made as to the printed record in both cases. A copy of re-issue patent 14182 was thereupon offered in evidence as "Plaintiff's Exhibit 1." Thereupon a cut of a photograph filed by defendant upon the preliminary hearing was offered in evidence and attorney for defendant admitted it to be a correct photograph of defendant's construction. This cut was marked "Plaintiff's Exhibit 2" and received in evidence. Mr. Griffin thereupon offered the original patent and the same was marked "Plaintiff's Exhibit No. 3, No. 841741." Thereupon pages 26 and 27 from a booklet entitled "Kahn Building Products. Trussed Concrete Steel Company, Youngstown, Ohio," now the Truscon Company of Youngstown, Ohio. Pages 26 and 27 admitted to be put out by defendant was offered and received in evidence as "Plaintiff's Exhibit No. 4."

Q. Will you describe the way the Truscon Spir-

(Testimony of George E. Vandenburgh.)

als are secured to the longitudinal spacing or reinforcing bars?

A. I have a small model of it.

Q. I want you to describe it for the record.

A. It is not exactly as they turn it out. They turn it out with a "T" instead of the flat bar. In the bridge at San Diego, California, they used the flat bar, 1-3/4" wide, 3/8" thick bar. They so arranged it with the slot right down in and they hit both these sides to form the overlap. That is, they hit one side and there they hit it on both sides. No matter if you hit one or both sides, it is the same thing. This is mine; I cut in this way, and we strike it on the bevel, hit the one side or both, it is the same thing, and turns out with the same results exactly. I made this like the bars that were used in that bridge at San Diego, California. They are putting in four now. They put in two fastened and two extra ones when they set it up. In the patent drawing I used one bar. They can use any amount of bars they see fit to use, and this type of spiral construction with perpendicular bar is used in columnar construction for beams. They used a single coil. You see, in the cut there is two types, with coils single and double, one wound right and the other wound left. Those drawings were got up some years ago, and drawings in them days were not as fine as they are today and everything was not put in. I have seen several different sizes of bars but only one size in the "T" bar that I would call one

(Testimony of George E. Vandenburgh.)

inch or 1-1/4 inch; I did not measure it. The small model is here introduced in evidence as "Plaintiff's Exhibit No. 5."

(Pages omitted in narrative reduction.)

(Testimony of George E. Vandenburgh.)

CROSS EXAMINATION BY MR. GUTHRIE:

Exhibit No. 5 is intended to represent the inclined cuts or kerfs covered by the patent. In the model last referred to, the wire or rod is held by smashing down and forming a kerf on one side of the right angle cut. The Truscon Steel Company had a kerf on both sides in 1914 where the kerf on one side will do the work as well as the kerf on both sides. At the time this suit was commenced the Truscon Company was using a coil embraced in the cut in a "T" bar, and I know positively they used both. The defendant was using a "T" bar before I commenced this suit. I did not mean to suggest to the Court that any column hooping made by the Truscon Steel Co. at any time had bars in proportion to the rods as disclosed in Exhibit 5, as that is not put up by scale.

Mr. Griffin: An objection is here made on the ground that it is immaterial what scale the bars are.

I do not contend that the model is made to scale. Defendant's Exhibit No. 1 is the only style of its construction I have seen and correctly represents it. I helped install the Kahn reinforcing bar, the sheared bar in Freedman Hospital in 1906, as this work was begun as soon as the season opened in 1906. I think in July, something like that, I couldn't say the time. The construction was not similar to any I saw in Kahn patent No. 736602. The construction I helped to install in Washington had a main longitudinal tension member at the bottom and running

(Testimony of George E. Vandenburgh.)

up obliquely from it on each side of the center and on opposite directions from each side of the center were subsidiary web members.

Mr. Guthrie: I move to strike out the statement that he made the invention in 1903 and first employed it in February, 1903, as a conclusion.

The Court: I will overrule the motion.

Vandenburgh: Two different licenses were taken out, one last year and one three years ago, 1916. They were different manufacturers. The 1916 license was after the re-issue of the patent to a Chicago concern that had put up a building in San Francisco. I threatened to sue and they paid the royalty on one building and then went out of business. The Corrugated Bar Co. of Buffalo was the 1919 licensee. I never had a suit with them. I had never seen this hooping until after I got my original patent out. I did not try to enforce my patent prior to its reissuance. I tried energetically to get my construction on the market for columns and piling. I never got anybody to go into it. There were too many agents for the other stuff against me. All the concrete engineers were solicited by agents for every style of construction to put up their design.

Q. Why did you not sue some of them for infringement?

A. They hadn't the same as I was, as mine.

Plaintiff thereupon rested.

Mr. Guthrie: Defendant offers as "Exhibit 2" all the patents pleaded in the answer, and offers as

(Testimony of George E. Vandenburgh.)

"Exhibit 3" from the record of the Pittsburgh case commencing at page 175 to and including page 186 consisting of extracts from "Experimental Researches on Reinforced Concrete."

(Pages omitted in narrative reduction.)

(Testimony of F. E. Turneaure.)

Thereupon defendant called

F. E. TURNEAURE

who, being first duly sworn, testified as follows:

My name is F. E. Turneaure living at Madison, Wisconsin, age 54. I am dean of the College of Engineering of the University of Wisconsin.

Mr. Griffin: I will admit the professor's qualifications. I have read his articles many times.

I have written several books on reinforced concrete.

Q 9. Will you kindly explain to the Court the respective functions of the metal reinforcement and the concrete in a reinforced concrete beam, with reference to what is known as a beam connection in the science of concrete reinforcing?

Mr. Griffin: If your Honor, please, I must object to that as irrelevant and immaterial. This case is limited to columns and the way beams, slabs or columns may break is of no moment as to the construction involved in this patent.

Objection overruled.

(Exception by plaintiff.)

A. Thinking of a beam as in a horizontal position, with a load on the top of it, the principal stresses resulting in the beam are the tension stresses on the lower part of the beam, the lower half, and compression stresses on the upper half, these being greatest near the center of the beam. There are other stresses which are less important. Now, con-

(Testimony of F. E. Turneaure.)

crete being a material of great strength in compression and of small strength in tension, is not well suited to act as a beam without reinforcement. So to carry the tensile stresses in the lower half of the beam, the first step really in the development of reinforced concrete was the insertion of metal rods near the lower side of the beam, longitudinally, so as to carry those tensile stresses. That was really the first step in reinforced concrete beam design. Now experiments and practice proved that the reinforcing was not sufficient, that a heavily loaded beam, and especially a deep beam compared with its length, would develop other stresses, especially near the ends of the beam, and if this reinforcing rod is inserted horizontally in the beam and is straight throughout its entire length, the beam would develop diagonal cracks near the end of it which would cause failure, even though the center of the beam might be perfectly sound.

Defendant's Exhibit 5 was here offered and marked.

This illustration fairly represents what I mean by diagonal cracks. To overcome this tendency to crack in a diagonal fashion near the end of the beam, various devices were applied in the way of reinforcement, either in a diagonal or vertical direction, this secondary reinforcement to be connected in some way to the main horizontal rod. With these secondary members added, the metal reinforcement became more efficient.

(Testimony of F. E. Turneaure.)

Kahn patent No. 736602 illustrates the method of meeting these diagonal fracture stresses.

Q. 12. In a construction of that kind, to what extent is the tension developed in the main longitudinal transferred to the subsidiary diagonals, not in figures or percentages, but in what manner?

A. At the center of the beam, the ordinary beam, supported at the ends, all of the tensile stress practically is taken by the horizontal member. Now, as you pass from the center towards the ends of the beam, the stress in that horizontal member is transferred gradually to the concrete and to these secondary diagonal members. Of course, at the very end of the member, where the member ceases to exist, all of that stress must so have been transferred. Now a considerable part of that stress is transferred to these secondary diagonal members, just exactly how much it is impossible to say. The longitudinal is the main member and the diagonals are secondary members, to strengthen the concrete in this diagonal direction.

The Pohlman Patent No. 766899 with its loops d, attached to the main member a, appear to have the same function as the diagonals of the Kahn patent, and the same may be said of the Peabody patent No. 805663, Figures 1 and 2. This is also the function of the obliquely extending loops 6 of the Golding Patent No. 815157.

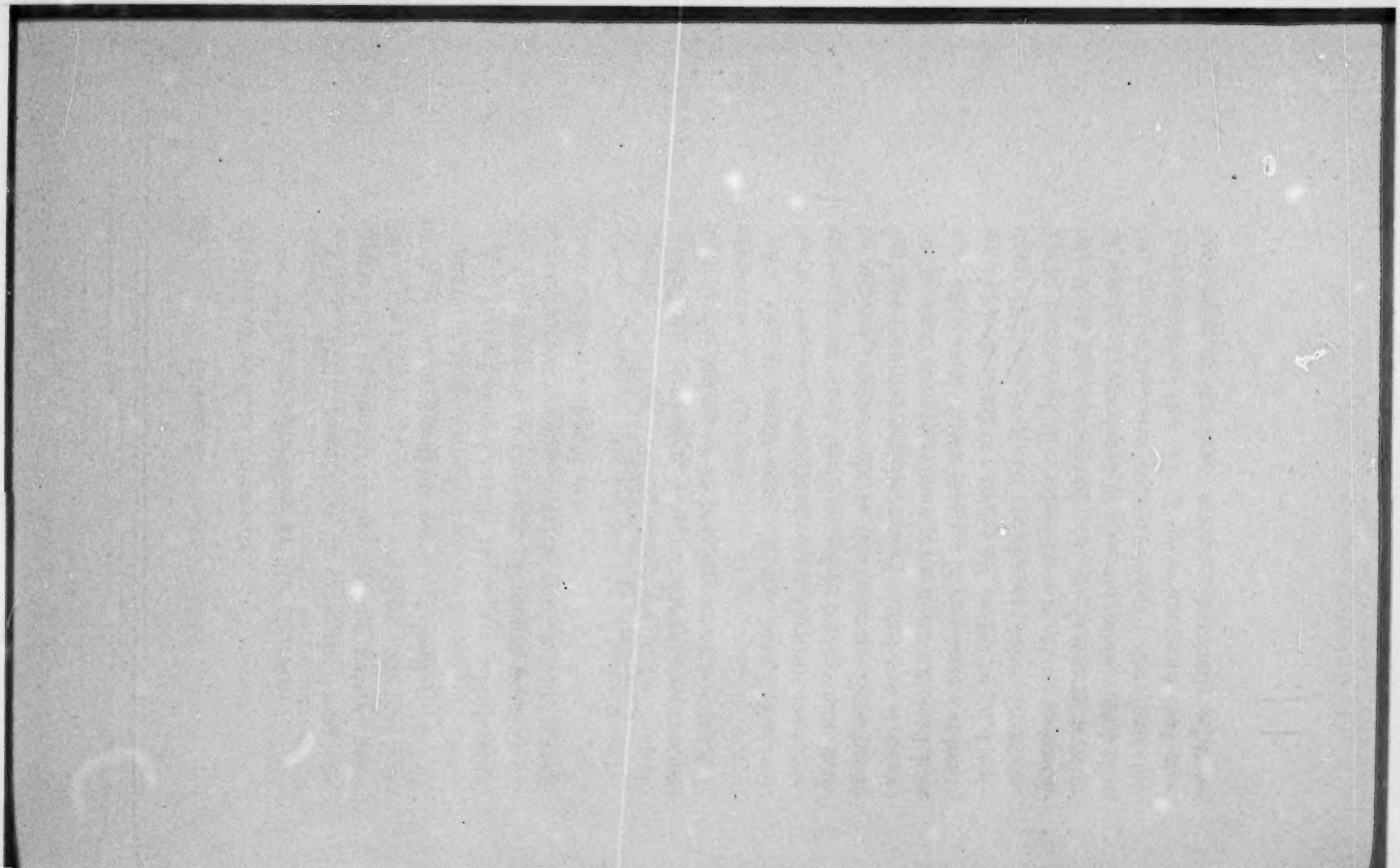
In the Kahn patent the method of securing the diagonals to the main member either involved the independent attachment of the diagonal members by

(Testimony of F. E. Turneaure.)

rivets as in figure 10, by boring holes and inserting rods as in figures 24, 26 and 29, or the shearing of the bar itself and the bending up, as in figures 21 and 22.

The Golding patent was intended in the way of development, to devise a main bar, the attachments to which would not change the sectional area.

(Pages omitted in narrative reduction.)



(Testimony of F. E. Turneaure.)

CROSS-EXAMINATION BY MR. GRIFFIN:

XQ23. With respect to the way the loops are shown held to the bar in the Golding patent, page 320 of the Pittsburgh record, would you say that that mode of fastening could or could not develop the full strength of these loops?

A. Well, I should hardly think it would develop the full strength of the loop. It might possibly be so constructed it would be fairly good, but not a very good method, I should say.

REDIRECT EXAMINATION BY MR. GUTHRIE:

RDQ26. Professor, a beam of any construction or material can be set on end for use as a column, I suppose?

A. Yes, it might serve as a column. You get beam stresses or bending stresses, when the load gets off center or when there are other loads, which may be applied transversely to the column. Sometimes we have columns that have very high beam stresses, but a plain simple column with a central load has very little or no beam stress. If you have a column on which the load is applied off center to your column, it tends to bend in the opposite direction. There is some of that effect in a great many cases, but it is not considered a large factor generally. It has been considered to a considerable extent that the monolithic construction tends to distribute the load action so that all of the columns in that case have more or less beam action. Originally columns

(Testimony of F. E. Turneaure.)

were built on the beam principle mostly. The early reinforcement of columns in this country was carried out by means of vertical reinforcing bars which were intended to take part of the direct load. The steel rods would take care of their share in accordance with their elasticity. That was one method of reinforcing columns, and those bars were used quite extensively without any hooping or banding, except a little wire to hold the bars in place. That was the earliest form. Column stresses are now met in two ways.

The stresses in the column are, of course, pretty complex when you try to analyze them completely, but compressive stress in a column or long block carries with it a tendency to burst the column and to spread it sideways, to compress the material endways, and to shear off that material diagonally. Now, columns of different materials, where tested to destruction, will fail in different ways. If a column of plain ordinary concrete without reinforcement is tested, it will fail; if good concrete, it will fail by shearing off. You will have a columnar fracture at the ends of the broken column. Now, there is at the same time a tendency to burst. This is shown by the test of steel and wrought iron. It bulges out sideways, because iron will do that to some extent. Now, the first reinforcement, as I already stated, consisted primarily of vertical rods simply held in place at intervals. Now that did help support the direct load, but it did not help to prevent this bursting action, so that those columns would fail in about the

(Testimony of F. E. Turneaure.)

same way as plain concrete. Now early students of column construction—earlier in foreign countries than in this country—conceived the idea of banding a column to prevent the bursting action. Considerre, who is one of the earliest writers on the subject, explains the action thoroughly. I think about 1902. Banded columns of various kinds were used before Considerre. Now that banding, hooping effect, is entirely different than the vertical rod reinforcement effect, different altogether. It is to prevent the concrete from bursting laterally, and if a column of that sort is tested in a testing machine, it will show a very great degree of ductility. It will bend laterally, perhaps, several inches before it will break. Now since the development of that hooping, the two kinds of reinforcement have been used more or less together. Both rod and banding.

Mr. Griffin: We do not claim bands. We don't claim anything but spirals, in combination with the kerf method of attaching the perpendicular or longitudinal bar. As to the general action of columns and the benefit of spiral hooping, I agree with the statements of Considerre who disclosed spiral banding. I do not find in any examination of the Considerre reference anything about securing the longitudinal to the spirals by integral means.

The Vandenburgh patent describes and specifies a reinforcement for beams, that incidentally refers to this reinforcement for columns. The figures, with the exception of figure 6, show the arrangement of

(Testimony of F. E. Turneaure.)

the bar and the so-called coils, figure 1 illustrating pretty well the general idea.

Figure 1 shows the general arrangement of the bar and these spiral members as they would be used in a beam. Figures 2, 3, 4 and 5 are enlarged diagrams illustrating the details of these coils. As shown in figure 1, these coils are arranged around the bar in a diagonal, so that they slope in a diagonal direction—to the right of the center and to the left of the center—with the apparent purpose, evident purpose, of taking care of these diagonal tensile stresses which I have explained occur in beams. The principal reinforcement is the horizontal bar. The coils constitute a secondary reinforcement, which, in other patents, is provided for in other ways. Figure 6, with two references, I believe, in the descriptive material, indicate that this bar with these coils may be used in columns. That, in general substance, is what the description conveys to my mind. The descriptive references to truss action in the patent indicates that a bar with secondary members, as described here, constitute the metallic frame-work, which in connection with the concrete in a beam, make together a sort of truss; and the general principles of truss action, as actually used in connection with such an arrangement, a truss being a frame-work acting as a beam, so that the steel or metal reinforcement, together with the concrete, constitutes his truss which acts as a beam.

A beam is generally thought of as a solid continuous material, an ordinary bar supported at each

(Testimony of F. E. Turneaure.)

end. A truss performs the same services as a beam, except that it is made up of individual members, such as a frame-work for bridge work. Covers a span, doing the same work, but more economically than a beam.

RDQ39. Examining Plaintiff's Exhibit 2 and Defendant's Exhibit 1. Do you find in the Vandenburgh reissue patent anything describing to you or even suggesting to you a construction of the character of Defendant's for columnar reinforcement?

Mr. Griffin: If your Honor please, I object to the question as purely calling for a conclusion of the witness. It is a matter that the Court has to interpret.

A. No sir. The Vandenburgh patent reads in an entirely different direction. Assuming that we had no previous knowledge of the distinct idea of band, spiralling or otherwise encircling and embracing columnar concrete, I would not find in the Vandenburgh reissue patent anything to suggest the adoption of that method of construction. The reason for that is the Vandenburgh patent relates to the reinforcing for a beam, a combination of a large horizontal rod with secondary coils, so as to form what is called truss action. This is mentioned a number of places in the descriptive material. Now, figure 6 shows how two of these bars with their coils might be put together, an impracticable arrangement, however, for use in a column. Now one knowing about beam reinforcement would appreciate the desirability of placing those coils in a diagonal direction, as shown in all of those cuts. One would understand

(Testimony of F. E. Turneaure.)

also that these large rods, placed in a vertical direction in figure 6 would reinforce a column by the vertical action of the rods, but I do not think anyone would get an idea from figure 6 and this general description, of what is developed or what was developed at that time, in the form of spiral reinforcement, in which the spiral reinforcement performed a distinct function.

I take figure 4 as a mere detail or piece of figure 1, because in the description it refers back to figure 1 in mentioning figure 4. Figure 1 shows the entire construction and figure 4 a mere detail, assuming a single coil. Figure 3 shows how the thing can be made, using a double coil. In figure 6 all of these coils are inclined in the same manner as they are in the diagram in figure 1. It does not appear that they suggest at all the fundamental notion of spiral and hoop reinforcement as the primary reinforcement. Furthermore, figure 6 illustrates what has been done with other kinds of beam reinforcement when used in columns. When put in there, it would give the idea these diagonals do some good, but it is not a very scientific arrangement.

Figure 6 is impracticable because the coil is bunched together like that, and it does not occur to me you would get a very good job of concrete, and it does not appear to me you actually could with the coils so closely meshed together as indicated in that figure. The coils would interfere with the tamping of the concrete. You could not get a good quality of concrete.

(Testimony of F. E. Turneaure.)

The actual function and purpose of the longitudinal in concrete columns is that of spacing pieces. Practice and results do not call for that bar to be of any greater strength or dimension than is necessary to keep the coils in place during the period of pouring in the concrete. Engineers in calculating the strength of concrete columns do not take into consideration as reinforcement the longitudinal bars.

In a construction such as is shown in Defendant's Exhibit 1, if the total sectional area of the longitudinal, even if not reduced by cutting of the slots, does not exceed 7/8 of an inch, I could regard this reinforcement as of no consequence, assuming you would not put in enough bars to make a filler. It is possible to put instead of these, additional large bars, which is sometimes done. In the beam reinforcement of the type of the Vandenburgh patent the bar is the chief thing, and that has got to be designed in proportion to the load.

RDQ54. Now in designing or fabricating this type of column hooping construction, by what rule, or according to what practice, or because of what element, would be determined the question of whether the reinforcing spiral was attached to the spacing bar by one kind of weld or another kind of weld, or by tying on with wire, or riveting it on with rivets, or running it through a hole in the bar, or using special metal clips between the bar and the spirals, or the cutting of notches, or the cutting of diagonal

(Testimony of F. E. Turneaure.)

kerfs, or some other method of affixation, what would determine the selection in that respect?

Mr. Griffin: I object to the question as entirely irrelevant and immaterial.

A. That would be a matter of personal choice in each instance; that is, the judgment of the designer.

(Pages omitted in narrative reduction.)

(Testimony of F. E. Turneaure.)

RECROSS EXAMINATION BY MR. GRIFFIN:

RXQ57. Professor, beam reinforcements were largely used in the production of columns in the early days of the concrete reinforcing art, were they not?

A. To some extent, yes sir. Columns have some bending stresses in them and sometimes they are designed with particular reference to those and sometimes not. They are sufficiently strong but that does not necessarily involve any steel reinforcement for that purpose. That is to say, there may be no special reinforcement in the column for that purpose, although the designer well knows there is some beam action. And although that is taken into account in making that design, there is a great deal of construction in which the designer judges the beam action is small and he can disregard it entirely. Even if the loops of concrete reinforcing are not circular, are not exactly evenly disposed, they still have some effect as reinforcing. Square rectangular loops I would not say give good reinforcing effect. I think a rectangular loop is a very poor kind of reinforcing. It may be largely used, but I do not think it is largely depended for true hoop reinforcement. If the hoop is not perfectly circular, or slightly unevenly disposed it would still be reinforcing. It is a matter of relativity, I suppose, whether good or bad. The spirals need not be exactly uniform.

In an examination of the Vandenburgh patent I do not find the structure limited by any wording to

(Testimony of F. E. Turneaure.)

beam construction. I don't say it was expressly limited to beam work. I mentioned others.

I find in Plaintiff's Exhibit 2 and Defendant's Exhibit 1 spirals with a longitudinal connection bar, means integral with the longitudinal connecting bar to hold the spiral in each instance, and in each instance the spiral is seated in a slot in the edge of the longitudinal bar. There would be nothing inherently impossible in intermeshing two coils as are shown in Figure 6.

RXQ77. You are familiar with the fact that the Patent Office drawings are never made to exact scale?

A. No: but this inclination in this drawing was evidently made with a very distinct purpose, because everybody who knows enough about concrete, knows that inclination is worth something in a beam and is not worth anything in a column.

There would be no serious disadvantage in intermeshing two such coils of the same size. In the matter of taking care of truss stresses the spiral form and band form are substantially the same thing. The spiral is not regarded as having distinctive superior merit. It is a matter of having the spirals placed close enough to perform their function. Spiral reinforcement used alone makes a very tough, reliable, ductile column, which will bend without breaking. It does not burst or shear off. You can bend them three or four inches out of line. Now, if you want a smaller sized column that will bear a heavy load so that you don't have to take up a lot of space with it,

(Testimony of F. E. Turneaure.)

you can increase the strength of the column by putting in longitudinal rods wired to them in some convenient way, and when walled in with vertical rods they help to take the load, and the number of vertical rods is up to the engineer in designing the particular structure.

RXQ83. Why is it that most of the spirals used today are used in connection with spacing bars to which the spirals are connected by means integral with the bars; that is, by spurs or corners hammered down?

A. I suppose it is more economic and convenient to make them that way. They are easily set up in the shop, easily handled, easily shipped and it is easier to get them in a uniform position.

RXQ88. In fact, there are a number of advantages of such a construction, are there not?

A. There are some I can think of. I am not a practical builder, so I probably haven't thought of all of them. There are advantages. There might be over some other construction. I do not have any in mind now, but it is very evidently a good arrangement.

(Pages omitted in narrative reduction.)

(Testimony of F. E. Turneaure.)

REDIRECT EXAMINATION BY MR. GUTHRIE:

I meant simply to say that not only bands but spiral hooping must be fairly close in order to have this protective action. If you put the spirals in there in the right distance apart or bands either, for that matter, that band will accomplish the purpose or function. I don't believe I could give offhand the relative distance that should exist between the spirals. It is pretty well standardized right now. It would be well outside of the standard if the spirals were the distance apart nearly and substantially half of the diameter of the spiral that would be too wide.

Mr. Guthrie: We offer from the Pittsburgh Record the file wrapper and original Vandenburgh application. Also the file wrapper of the reissue patent at page 353 of the Pittsburgh Record. We also offer from that record patents to McClure, Wedmore and Clement shown on pages 381 and 384 and 387.

Mr. Griffin: I object to the subsequent patents offered.

Objection overruled.

(Pages omitted in narrative reduction.)

(Testimony of Julius Kahn.)

Defendant thereupon called

JULIUS KAHN

who, being first duly sworn, testified as follows:

My name is Julius Kahn, my residence Youngstown, Ohio, my age 46. I am president of the defendant company and have been since its organization. The company was originally organized to manufacture the Kahn truss bars disclosed in patent 736602 and began the manufacture of column hooping about 1907 or '06. Column hooping abroad became active about 1902. In this country I would say they began to adopt it about the same time we started in business, in 1903. We didn't in reality adopt it until a couple of years, I would say, after we started in business. Column hooping was not a manufactured product at that time. The manufacturing has been limited pretty much on the assembling of the hooping with a spacing bar. Previous to that time spirals, merely as such, were used and were wired to longitudinal reinforcing rods in 1902 and 1903.

Considere, as a matter of fact, did not assemble the complete construction at all; he just had the spirals which were wired to a vertical bar or vertical bars.

Q8. When did your company first begin to provide either for the assembly in the field or manufacture for shipment—I don't care which—the longitudinal bars with spaces cut out of some part of the longitudinal for the receipt of the coil?

(Testimony of Julius Kahn.)

A. I would guess about 1906; I am not too sure of my dates. We originally used a flat bar for about five or six years. We have used some angle bars. I would say we began using the T bar about 1910 or 1912. We originally used a flat bar made up of a section which we had rolled, and which we called a washboard section, which had just a little prong integrally connected with the main member. I would judge we abandoned that about 1910 or 1912. After that we used the T which we are using now, which had a little rectangular cut, in its side. We inserted the spiral into that rectangular cut, and by means of a tool, hammered down the sides of the cut on the spiral. The construction illustrated in Defendant's Exhibit 1. This was adopted about 1910 or '12.

Mr. Griffin: In the Electric Welding case you said you fixed the date of your using the spirals with the integral fasteners as of December, 1907. You speak now of 1906. Is that the same thing?

The Witness: I assume it was, yes. Did I give the reason for it there?

Mr. Griffin: Yes.

The Court: That, you say, was of the washboard type?

The Witness: Yes sir; that was of the washboard type. Apparently the dates must be given on the circular here.

The Court: Your recollection of it then was probably more accurate than your present unrefreshel recollection?

The Witness: Yes sir. It says in this testimony

(Testimony of Julius Kahn.)

the date is fixed by the circular, but I do not believe he is giving me the right circular.

Mr. Guthrie: We are not claiming this is in anticipation, so it is not material.

The circular marked Defendant's Exhibit 5 shows what we call the washboard section.

Q19. Now, Mr. Kahn, commencing with the time when you commenced the construction shown in this Exhibit 1 was there anybody else at that time manufacturing and selling column hooping, where the hooping, either banded or spiral, was affixed to the spacing bar by means integral with the spacing bar itself?

A. Yes, the Smith Wire & Iron Works of Chicago.

Q21. Anybody else you know of?

Mr. Griffin: I don't like to be objecting, but I must object to testimony of this character, because it is subsequent to the time that anything can have any effect on the patent, and it is irrelevant and immaterial.

A. My recollection is that also the Corrugated Bar Company of Buffalo, and the Electric Welding Company of Pittsburgh assembled their column hooping along the same lines.

The Court: I did not rule on the objection. I do not see the materiality of what other people did after the patent, unless you are attacking the reissue patent on the ground they had no right to reissue.

Mr. Guthrie: That is one of the positions—respecting intervening rights under the reissue patent. The other is the question that always comes into these

(Testimony of Julius Kahn.)

cases of what art was built up while the patentee of the patent in suit lay quiescent with his paper patent. We will have illustration of what those people did.

Q22. Do you know anything about the Monolith Construction Company?

A. I am quite familiar with it. The Monolith Construction rolled a bar with two kerfs in the edges, and into those kerfs they inserted a small round bar and then submitted the main bar to pressure from a heavy press, which clinched the main bar on the little round bar seized in the grooved kerfs. They then wrapped the little round bar around the spiral reinforcing as illustrated on pages 293 of the Pittsburgh Record.

Q25. Do you know anything about how extensive a business was done by these other manufacturers you mentioned—the Smith Wire & Iron Works, the Electric Welding Company, the Corrugated Bar Company and the Monolith Construction Company?

Mr. Griffin: I object to any such question because it does not appear what kind of construction was made by the outside people, and unless it does, it is impossible to determine what weight it has.

The Court: I appreciate your objection, but I will receive it.

A. They did a pretty substantial business. I recognize McClure Patent No. 857821 as the construction used by the Smith Wire & Iron Works of Chicago. We were manufacturing this spiral as one of our regular products up to the time we had notice

(Testimony of Julius Kahn.)

of a claim on the part of Vandenburgh in 1917.

Mr. Guthrie: We think it may be agreed Mr. Griffin, that the Vandenburgh notice was sent out in the early part of 1917.

Mr. Griffin: In the early part of 1916.

Mr. Guthrie: After your reissue patent.

Mr. Griffin: We notified the trade prior to the reissue of the patent and immediately after the reissue we notified them.

The Witness: Prior to receiving the notice, since 1910, we have made about twenty thousand tons of this spiral reinforcing, and prior to that about ten thousand tons. The largest T bars we have ever used would be a trifle over three-sixteenths of a square inch in sectional area, before the rectangular cuts were made in the bar.

(Pages omitted in narrative reduction.)

(Testimony of Julius Kahn.)

CROSS EXAMINATION BY MR. GRIFFIN:

Our standard practice is to use bars three sixteenths of an inch in area. The Monolith Company used flat spiral bands. I don't distinguish between a flat band and spirals. It makes no difference in the engineering profession at all. It may have circular flat bands instead of continuous spirals. In connection with the Monolith bar, spirals were used. They took the bar and rolled it up like this. This bar is rolled. Now they inserted into this kerf here a small bar. Then by means of a press operation they rolled that around, and that clinched that wire there. Now for a hoop column, they used little wires and they allowed them to stick out, and they inserted the spiral into the little wires and clinched the wires over by means of a hammer. There were no means integral to the bar for securing the bars to the spiral or the spirals to the longitudinals.

Mr. Guthrie: I offer in evidence extracts from the Engineering News, appearing on pages 137, 327, and 392 of the record of the Pittsburgh case, with index of exhibits showing date, where they do not appear on the exhibits themselves.

Marked Defendant's Exhibit No. 6.

Defendant Rested.

(Pages omitted in narrative reduction.)

(Testimony of George E. Vandenburgh.)

Thereupon further to maintain the issues upon his part, plaintiff was called as a witness.

GEORGE E. VANDENBURGH

testified as follows:

DIRECT EXAMINATION BY MR. GRIFFIN:

In the Kahn bars that I have used for beam construction, the prongs were set according to the thickness of the girder or floor arch. The angle was dependent upon the thickness of the floor or the depth of the beam. I have had considerable experience, not wholly in the concrete business, but in several jobs through the country, some in California, one in Philadelphia, and several in Washington. Prior to the reissuance of my patent I tried to get it into the harbor business in San Francisco, and into the harbor business in San Pedro, but the steel companies there could not manufacture steel that would stand the pressure; they could not come up to five thousand pounds of the pressure required in the specifications to make it, so that we could not get any to do any business. I never intended this reinforcing for any particular style, just wherever an even spacing was required. The principle of it was to get the even spacing for the strain, in laying the concrete into the work, so that the wire can not slide. The sliding of the wire is what caused failure in concrete.

Q102. In your reinforcement were the spirals rigidly or flexibly connected with the coils?

(Testimony of George E. Vandenburgh.)

Mr. Guthrie: We object to the question for the reason that it is immaterial anl irrelevant.

The Court: Whether rigidly or flexibly connected?

Mr. Guthrie: The original patent in the claims said "rigidly attached." In the reissue it said "Permanently attached." And it was contended that "permanently" meant it would not fall out, and therefore he meant it could be collapsible.

The Court: I will hear his testimony.

A. The earliest ones I made never could be held out without wiring. They had to be held up, they collapsed. I have a bar that shows the first device I ever made, and shows that with the wire pulled out, they always collapsed. It is not possible to get a spacing bar to bind spirals such as are used in this case rigidly.

Q105. If the prongs were pounded down upon the spirals tight enough would that produce a rigid connection?

A. That depends on the hardness of the steel. If one steel is harder than another, it will close to a certain extent. If your wire is harder than your bar, it will spread up, widen out.

The Court: Why, if you hammered the spur, or what you call the kerf, down over the spiral, why wouldn't that be a permanent fixture or rigid fixture?

The Witness: It would be so hard before you could close it down. I have never been able to do it.

(Testimony of George E. Vandenburgh.)

There is one I pounded on a straight bar, pounded it down as far as I could. (indicating to Court)

The Court: This doesn't come out.

The Witness: They don't come out. They are not supposed to come out, but they collapse them.

Mr. Griffin: There is a difference between rigidly connected and permanently connected. We contend it is a mere permanent connection which is intended in the specifications, but through inadvertence the wrong word was put in the claim issued and the reissue patent was to correct that defect.

The Court: How do you mean collapse?

The Witness: Just like this (indicating).

The Court: If you used two spacing rods, how would you do that?

The Witness: It would collapse if one is put with the other. During the years following the grant of my original patent, my financial condition was bad. I have had about six bad falls, through building, and at that time I had had a bad fall. I am bandaged now; I carry a bandage on there all the time; and then I had lost money in the bank failure in San Francisco, the California Safe Deposit Company, and I had been out of work a great deal, work had gotten very slack after the earthquake for a couple of years, and I would work along until I got money and then stop and try to do something with the patent, but the bricklayers were against me. I am a bricklayer by trade, and belong to the union, and they were against me because I was trying to introduce concrete reinforcing on the market, and at that time

(Testimony of George E. Vandenburgh.)

they would not allow anything like that to go on a building. It would have to go on separate and not reinforced. Everything would have to be fabricated on the job, and the bars shipped separate and the coils shipped separate. All those things prevented me from exploiting my patent. I didn't have any money to work on. Had no intention of defrauding anyone.

Q110. Where did you first make this invention?

A. In Washington, D. C.

Mr. Guthrie: We object to that as calling for the opinion and conclusion of the witness.

The Court: Haven't you asked him that on the stand before?

Mr. Griffin: He answered the year as 1903, and I wish to ask him what he did to develop it.

A. In February 1903 I made models, six or seven different models. Some were first made up of wood and wire, and then I cut them out of steel and wire. Then I couldn't go on because my mother died and I had to bury her, and I had that expense, and then I got married and I had a great deal of expense going housekeeping, and then my wife's mother, I had to give her a monthly allowance. It seems funny, but I had something on my hands all the time. The models were the same as the drawing in the patent.

Mr. Guthrie: We move to strike out the answer as not a sufficient standard of proof for anticipation.

The Court: Your motion will be overruled, and I can take care of it just as well when I am disposing of the case.

(Testimony of George E. Vandenburgh.)

A. I fixed the date of the making of the models from living at 1803 Oregon Avenue. I rented a room with B. Blethyn, where I made my home. I rented it in April and I lived there and I made those models in his shop before I left his home. When I went to California, I left all the models in his place and I didn't take any models with me.

Q117. Did you ever test the models of your reinforcement?

A. I did in June, 1906 on the Government reservation at the New Freedman Hospital building, Washington, D. C. A breaking test on the floor slab and girder. This test was made on a government reservation and they would not allow me to dig down to put a column in and I couldn't do it above the ground on account of too much danger to the people, and they wouldn't allow me to test that. The Government inspector was there and I had to abide by his decisions. We invited a large crowd of people out to see the test; it was public.

Q122. Is it practicable to use a flat bar with prongs on the flat side of the bar for connecting to the spirals without a radially extending member for holding the spiral in proper position?

Mr. Guthrie: I want to formally object. This gentleman has not shown himself qualified as an expert.

Objection overruled.

A. It is not. It would be too much danger of buckling. You understand, you take that bar and put it out here, and if you had a quarter of an inch

(Testimony of George E. Vandenburgh.)
thick, you would have a quarter of an inch, but where you put it edgewise this way, the buckling out would not get it.

(Pages omitted in narrative reduction.)

(Testimony of Benjamin Blethyn.)

Thereupon plaintiff called as a witness

BENJAMIN BLETHYN

who, being first duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. GRIFFIN:

My name is Benjamin Blethyn. I am a builder; was engaged for the last 36 years in Washington, D. C. I have put up reinforced and almost all kinds of store buildings or anything that comes along. I first knew Mr. Vandenburgh about thirty years ago in Washington, D. C. I saw him working on spiral concrete reinforcing in my shop in 1903. He was making them out of wood there to start with. He made five or six or probably more until he got it satisfactory.

Q12. Will you describe the character of concrete reinforcing that Mr. Vandenburgh was working upon in 1903?

A. It was more of a spiral construction.

Q13. Will you describe it fully?

A. First of all he made it out of wood and then that was intertwined with wire. He started to looping the wire, and then bored the holes in the rod to make it stay where he wanted it. He worked on several different forms until he got it satisfactory, and then he made it out of steel.

Q. I want you to describe it, particularly the bar reinforcing.

A. As near as I can. There were some girders and some columns. He had spirals and flanges in

(Testimony of Benjamin Blethyn.)

the beams so they would hold the spirals in place.

Q. What held the spirals in place?

A. The wire. He had holes in the wood, and he had little spurs to hold the wire until he would get it to the pitch.

Q. You were speaking of his having made it in steel?

A. He had the prongs and clinched them down. He bored a hole and put them through the slots and then clinched the slots to hold the wire. The prongs were upon the bars.

Q18. I will now show you a copy of plaintiff's reissue patent, "Exhibit No. 1" and ask you if you can identify any of the models then made with the drawings illustrated in the patent?

Objection overruled.

A. Yes sir; I can recognize them all.

Q. Did you ever make a test of the Vandenburgh reinforcing?

A. Yes sir, in the Freedman Hospital grounds. It is a Government reservation. In making that test I got all the appliances for making the test, the weights and all the facilities to do the work. I sent out 300 cards to Government officials, leading builders and architects in Washington.

Q. I will show you a card and ask you if you recognize that?

A. That is my handwriting, "June 23, 1906." I had that card printed in Washington and sent it out to Mr. Vandenburgh's father in Ballston Spa, New York. The date is June 23, 1906.

Mr. Griffin: This postal card, addressed to Mr.

(Testimony of Benjamin Blethyn.)

John M. Vandenburgh, 122 Saratoga Avenue, Ballston Spa, New York, bearing postoffice date of Washington, D. C., June 23, 1906, and also Ballston Spa postoffice, evidently June 23, 1906, and upon the reverse side reading as follows: "Washington, D. C. Sir: You are invited to be present at the New Freedman's Hospital Building, Monday June 25th, 1906, at 3 o'clock p. m. to witness a Crushing Test of the Vandenburgh Reinforced Concrete System, to be made by the Computing Engineers of the Building Department. Respectfully, Benjamin Blethyn."

I will ask to have it offered in evidence and marked "Plaintiff's Exhibit 6."

Q. What did you have at that place—what construction did you have to test?

A. Well, it was steel plates from the Metropolitan. They had plates that weighed 150 pounds each, and I was acquainted with the president of that company, and he allowed me to get as many plates as I wanted to be used as weights.

The constructions that were crushed were the girder and the platform. We made a platform, 10 feet by 14, and the girder was ten or twelve by eight. I think eight by twelve, and I think the platform was ten by fourteen, six inches thick. We made the girder right on the place. I have the steel today, most all of it. I have one or two bars that got crushed at the time.

Q29. I will show you a bar with four notches in it, and ask you if you recognize it?

A. Yes sir; that is the original bar, one of them. I

(Testimony of Benjamin Blethyn.)

had it in my shop in my warehouse. Mr. Vandenburgh just cut it to suit the suitcase. That is, two of them. I can furnish them fourteen feet long today. I think probably I have eight or ten of them. They are still there today.

The bar was offered in evidence and marked Plaintiff's Exhibit 7.

As a practical builder I could take the construction shown in the Vandenburgh patent and produce satisfactory buildings of different sizes and for different loads. The New York building code says with respect to such fastening of the spirals to the longitudinals that bars be not less than four fastened with a clasp; something of this order. The wording used in connection with it is that it has got to be a rigid reinforced bar.

(Testimony of Benjamin Blethyn.)

CROSS EXAMINATION BY MR. GUTHRIE:

Q39. Suppose you wanted to build a beam to support a floor area with a dead load of from 50 pounds to the square foot, to a live load carrying capacity of 150 pounds to the square foot. How much steel and how much concrete would you use under this construction, and how would you use it?

Mr. Griffin: I object to the question as calling for an answer from the witness without certain data supplied him as would be necessary to have him give an answer.

A. It takes an engineer to do that kind of work and I don't claim to be an engineer.

The Court: The only factor that seems to be missing is the size of the floor. If you could give him the size of the floor—

Mr. Guthrie: They have admitted he can not do it; that it is an engineer's job.

The Court: You are not an engineer?

The Witness: I do not claim to be. I am a practical builder. If an engineer designs what he wants I can build it. I can tell how much steel to use, what kind anl how close to put it together. I have had experience enough to do that.

XQ43. We will assume a school room floor. The floor is supported upon a brick wall, brick foundation wall, the floor inside the walls is 40 x 90 feet. They want a live load carrying capacity for the children and desks, and so on, in the school room of 150 pounds for the square foot. Now, you can design the beams

(Testimony of Benjamin Blethyn.)

and girders and concrete construction any way you please; just give us any design that would meet that carrying capacity and not exceed it substantially so as to have a waste of material. I turn you loose to figure it any way you like.

A. All right. (Witness figures) It requires for girders for a room of that size—

XQ44. First, what is the size of the girders?

A. The girders will be twelve inches by thirty inches deep, forty foot long. It requires 1-1/4 inch rods at the bottom and two on the top, and above the platform they will have to be about every 16 feet apart. The girders will have to be about 16 feet apart, and the platform will have to be 5/8 rods, 6 inches on centers, and 6 inches thick. I have already constructed a building of that size and just about that dimension, and it is up today and satisfactory and passed all the building requirements. That is what they call the Bristol School today. It is a four-story structure. I designed it. I was architect to the whole job. Between the time that Mr. Vandenburgh made his models and the time of the test he worked with me several times. He was working at his trade and he was in very poor health at the time. He wasn't working all the time.

XQ48. What led you to make this test in 1906?

A. Because that is the time he had it perfected and he had been down south and probably had improved his health and wanted to go ahead. I don't say he had it perfected, but that is the time he had his money. He had it perfected in 1903. Pretty

(Testimony of Benjamin Blethyn.)

near all of it; what I have seen. I could tell anybody, as far as that goes; it is the beams on the columns.

XQ53. What part of the beam did he have perfected—what brought it to perfection?

A. His own way of working. I had nothing to do with the working of it, only he was trying to work it out in my shop. He told me it was all right and he was going to test it out.

XQ55. He didn't test it for three years?

A. That is his own business; not mine. I had nothing to do with that.

XQ56. This piece of steel marked "Plaintiff's Exhibit 7," that, you say, was cut off a rod 14 feet long, and used in this test in the Freedman Hospital grounds?

A. Yes I swear to it and the wires were about the size of the holes that are in the bar. I used plain bars but not everybody did. There were diffeerent kinds of construction.

XQ62. There were very few people that used these fancy contraptions with the slots on the main bar?

A. Very little was known of concrete reinforcement at that time. The main bar and the reinforcing wire was depended on as much as anything else. The reinforcing wires and main bar are not so much out of proportion.

XQ66. The wires weren't any larger than would go through these little holes?

A. In Defendant's Exhibit, Picture here, Figure 1, you see the loops inclined in one direction on one

(Testimony of Benjamin Blethyn.)

side of the center, straight up and down in the center, and then in the other direction at the other end of the center. Now this bar that was cut off, had these little slots in the bottom for the wires running in one direction on one side of the center about seven feet, and in the other direction on the other side of the center for about seven feet. Where he had it doubled, he has the wire a little smaller for the double wire. Two wires in the same loop in which event he used smaller wires. Not all of Vandenburgh's models had the kerfs cut in them running in one direction on one side of the center and the other direction on the other side of the center. The columns didn't have to have that only the beams.

XQ72. Where did you see him put up the columns?

A. I seen him put them up.

XQ73. You saw this up?

A. I didn't see them.

XQ74. You don't mean to say he had a column up out there?

A. I didn't see him make any test of any columns, but I see him make a test of that floor construction and the girder. A computing engineer is a building inspector and computing engineer on the building. He has to pass over the plans for the strength and construction of different buildings. He was the highest one we could get to come and make an examination and give the test. He came out there voluntarily to make the test. We put the weights on it, and he had the weights, different weights checked which

(Testimony of Benjamin Blethyn.)
were used to make the crush and he helped the other men. I had three or four of my own men there besides.

(Pages omitted in narrative reduction.)

(Testimony of Benjamin Blethyn.)

REDIRECT EXAMINATION BY MR. GRIFFIN:

The engineer made some observations at the time of the test. He had his instruments and data of the weight, and when it was broken; he had all of that.

Referring to Plaintiff's Exhibit 4 and the hooping of the column that says three-sixteenths as the size of the hooping, I have never seen any as small as that. I have seen them from three-eighths up to half an inch. Three-sixteenths is rather too small, you couldn't get enough strength out of three-sixteenths.

(Testimony of F. E. Turneaure.)

PROF. F. E. TURNEAURE

recalled, whereupon Mr. Griffin admitted upon a question by Mr. Guthrie that the device known as a kerf in a longitudinal member for the purpose of attaching a transverse member by embedment in the kerf was in common use in the middle west.

Thereupon it was stipulated that the testimony of Professor Thayer could be taken before the stenographer on the day following the trial, and his testimony received the same as if taken in open court.

Thereupon plaintiff called

HORACE R. THAYER

who, being first duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. GRIFFIN:

My name is Horace R. Thayer; age 47; residence, Pittsburgh. I am a professor of structural engineering and also a civil engineer. Was engaged in it for thirty years. I have worked at it and studied it and taught it for thirty years, mainly in New England and Pittsburgh. I am at present with the Carnegie Institute of Technology, having been there fourteen years as a teacher of civil engineering anl structural engineering. I have appeared before in the litigation of the Vandenburgh patent in Pittsburgh in the case against the Electric Welding Company. I have recently examined that record and do not consider that my testimony in that case needs essential

(Testimony of Horace R. Thayer.)

modification. I notice one or two small errors in transcribing my testimony. They would not materially affect the conclusions.

I have examined the art and models made of record in that case, but did not find in that record or in the models made of record in that case any instance of spirals used in connection with longitudinal spacing bars having means integral with the spacing bars for securing the spirals in fixed positions, prior to the original patent. I have examined the patents offered in evidence in this case with the idea that those I had already seen in the Electric Welding Company case I had seen before, and those that were new I examined more carefully. I did not find any samples of spirals secured to longitudinals by means integral with the longitudinals, prior to the original patent.

The building laws of New York and Pittsburgh say as to the use of spirals that the connection of the spirals with the longitudinals must be rigid. There is a building now going up on Second Avenue near the Pennsylvania Railroad using the Kahn system in Pittsburgh.

Mr. Guthrie: We object to this testimony on the theory that if it indicates anything as to the rigidity or otherwise of the defendant's present structure, it is incompetent for that purpose. The building laws of Pittsburgh may or may not be enforced or may or may not be evaded.

Q22. Do you know of any instance in the City of New York of Truscon spirals being used?

(Testimony of Horace R. Thayer.)

A. No, I do not. Examining plaintiff's reissued patent I regarded Figure 4 as collapsible. I would think that all cases that would be likely to occur in practice, that is, with bars of the sizes that would be built in practice, would be collapsible if built of that type. You might get an extraordinary case where they would not be. In connection with ordinary concrete reinforcing it would be collapsible. I have seen as exhibited in Plaintiff's Exhibit No. 2, the construction differs from plaintiff's figure 4 only in very small details. The plaintiff shows a rectangular bar and defendant shows a T bar. It is only the minor details.

The fastening of the spirals to the bar in each case, is done in the same way by prongs which can be pounded down on the spirals that is, by means of prongs integral with the bar itself. It is the same general type of connection. In one case, the case of the Truscon, it goes in perpendicularly, and in the case of the Vandenburgh it goes in diagonally, at least as is shown in this drawing. Each one fastens to every spiral. I take it the bar is fastened to every spiral; each coil wherever the spiral crosses the longitudinal bar, it is fastened on this. It shows two prongs. As an engineering proposition it is the same. There is no essential difference.

Q34. What special advantages does the spiral reinforcing with securing prongs integral with the longitudinals have?

A. It has two very great advantages—the collapsibility of the column for shipping.

(Testimony of Horace R. Thayer.)

Q35. Prior to the placing of concrete?

A. Prior to the placing of the concrete, and the fact that it holds it in position, in its proper position as the concrete is being placed. These spirals—regarding them first—these spirals are bulky and of some small weight under ordinary conditions. As a consequence, it is very expensive to ship them in carload lots. On the other hand, it is much more economical to make them and put them up in the shop, and therefore it becomes a matter of considerable economy to be able to ship them collapsed. In regard to holding them rigidly in position, that is an extremely important point. Engineers dread something that they can not depend upon, and when the concrete is poured—you understand how this is made, they put a form around all of this and then the concrete is poured down and the man stands perhaps ten feet above this and he pours the concrete down in there and perhaps tamps it in to get it thoroughly packed around the column. Now, if this fastening is not rigid, it is very likely to be displaced, and if for any reason this bar were pushed down right up against this bar in here (indicating) we would have a space there six inches wide and it would be exactly the same as if these bars were only spaced every six inches, because that one weak point would limit the strength of the column.

Q36. You mean rigid with respect to the longitudinal movement?

A. With respect to longitudinal movement, yes, and also the same is true in regard to movement in

(Testimony of Horace R. Thayer.)

this direction (indicating) laterally, because, too, that is extremely important. We put about one and one-half inches of concrete outside of that. Now, when this was tested, that concrete scales off under a comparatively light load, the outside concrete. The remainder stays in and is the real working strength of the material. Now, if for any reason these get displaced laterally, it would also seriously affect the strength of the column, and engineers are very, very distrustful of anything that can be changed without their knowing it. This is one disadvantage of reinforced concrete. The reinforcement in the concrete is liable to be displaced by the ordinary operations of pouring and placing and tamping the concrete, and they want something they can rely on, just the same as if you were going to do business with a bank you would want a bank that you knew was on a firm basis. You want to put concrete and steel together and you want to be sure that the steel will remain in the place where it is intended.

Q37. Have you made any examination of the later art than the Vandenburgh patent to see if there are many patents on spirals with spacing bars having integral securing means?

A. Yes sir; there are several at least.

Q38. Without offering these patents in the record, can you give their dates and the number and name of the patentee?

A. To E. R. McClure, No. 992,970, May 23, 1911, No. 1,016,319 to W. H. Burk, February 6, 1912, to A. Bindley and C. J. Mogan, No. 1,115,490, Novem-

(Testimony of Horace R. Thayer.)

ber 3, 1914, No. 1,159,297, to C. A. P. Turner, November 2, 1915, to W. B. Hough, No. 1,172,026, February 15, 1916.

Q39. Have the spirals in which integral fasteners are used on the spacers more or less supplanted other forms?

A. Yes, I think they are the more desirable type. I could not say definitely what proportion of spirals is used with the integral fastening means in the buildings I have recently noticed. I know it is a better type of construction. There are more of these used than the others I think. I examined Plaintiff's Exhibit patent two years ago and regarded his disclosures and that of his original patent as sufficient to enable any mechanic familiar with this art to make satisfactory columns or other reinforcing, provided he was already familiar with the theory of reinforced concrete columns. That is, the theory of making the steel sizes of the proper size to carry any given load. The size of the steel and the pitch of the coils in any given case is determined from rules that have been worked out by prominent engineers, those rules being derived as the result of experiments.

Q46. What have you to say with regard to properly securing all of the spirals in a large sized building by other methods than the integral securing means?

A. Well, I should object to it unless it was such as to hold them rigidly in position. I mean by "rigidly" securely in position. Engineers generally

(Testimony of Horace R. Thayer.)

take the stand that it is up to the contractor to provide work that has proper qualities. They do not usually insist on certain definite things being done. It is a very great advantage. I would object to a column where that was not done because, as I just pointed out, the spiral that was not secured might readily be displaced from its proper position and weaken the column to just that extent. There is no other method that I know of of securing the spiral to the longitudinal that makes as good and efficient a job as the integral securing means. I have compared the mechanical structures of the Concrete Steel record with those of the Electric Weld record.

Q52. Did you critically examine the several patents of the Concrete Steel record and the Electric Welding Company record and compare the patents submitted in each record with each other?

A. Yes. I went over the Steel record, and where the patent was a new one, I looked at it critically. Where it was an old one that I had been over in the other record, I just passed it over. My recollection is that there were a few of the Concrete Steel record that were not in the Electric Welding record.

Mr. Guthrie: We may as well agree there were only two of them, Maxwell, No. 859312 and Barnes, No. 868065 that were not used in the Electric Welding Company case and were used in the Concrete Steel case.

Q56. As a result of your examination of the references in the two records, do you or do you not think that the Concrete Steel record has exemplifications

(Testimony of Horace R. Thayer.)

of substantially all of the means of securing spirals to longitudinals shown in the Electric Welding Company record?

Mr. Guthrie: The same objection. It is too general, even for an expert.

Mr. Griffin: I will waive that question for a moment.

Q57. Have you examined all of the patents in the Electric Welding Company record?

A. Yes sir.

Q58. Have you examined all of the patents in the Concrete Steel record?

A. Yes sir.

Q59. I will now ask the first question.

Mr. Guthrie: I renew the objection.

A. Yes I think it has.

(Pages omitted in narrative reduction.)

(Testimony of Horace R. Thayer.)

CROSS EXAMINATION BY MR. GUTHRIE:

XQ60. Where do you find in the New York record an exemplification of the means of attachment of coils shown in the Monolith Construction design shown on page 392 of the Pittsburgh record?

Mr. Griffin: The question is objected to as upon an example of concrete reinforcement bearing a date too late to be a reference against this patent, the date of said article in the "Engineering News" being March 15, 1906, whereas the original patent application was filed May 9, 1906, and to be effective as a reference against this patent, such disclosure must be two years prior to May 9, 1906.

Mr. Guthrie: We take exception to counsel's theory of the law. We can not understand how a man can be the first inventor of something that has been invented even the day before.

A. I looked over the two records and compared them in all cases solely with one idea in view, and that was in regard to the attachment of a spiral by integral means to a vertical reinforcing bar and especially in regard to reinforced concrete. Now then, I found in the New York case substantially the same general line of attack as in the Pittsburgh record, but I could not say that in some little details it was not a trifle different, especially where it did not concern this question. I have looked over these forty or fifty patents solely with that one thing in view, and outside of that I have not paid very much attention to them, outside of the questions we are contending. Perhaps I ought to qualify the answer to the question you asked me at the time when you

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asked me about that record. I went over all the new patents that were brought out in the New York trial. I did not pay any attention to the old ones that were duplicated, because I had seen them already. I was going over it for new matter and I did not pay attention to whether all the old matter was in, but I simply thought they were about the same as had been brough into the Pittsburgh case.

Q. You have testified, in answer to Mr. Griffin's question that you found in the New York record an exemplification of every means of attachment of the transverse members of the longitudinals found in the Pittsburgh record. Now, proceeding, will you kindly call my attention to where in the New York record you find an exemplification of the means of attachment shown in the Cummings patent of 1904, on page 157 of the Pittsburgh record, particularly figure 1, where the transverse members are held in place along the longitudinals by constituting the longitudinals of two units woven together so as to form a single longitudinal embracing integrally the bands at the points of connection.

Mr. Griffin: The question is objected to as immaterial and irrelevant, upon the ground that the patent referred to has no spiral reinforcement whatever, and that my question related to spiral reinforcement connections with longitudinals.

A. You get something of that idea in the Cummings patent, page 90, and also in the Peabody patent. It is not exactly the same, where the rod is wound around. It is not interlaced wire of the same

(Testimony of Horace R. Thayer.)

kind. But there is something of the same idea there and the same idea there (indicating on exhibit).

Q. That is, your idea is that the Peabody patent No. 805,663, shown on page 78 of the New York record, and on page 317 of the Pittsburgh record, is, from an engineering standpoint, substantially the same as the Cummings attachment in figure 1 of No. 764,883, shown on page 157 of the Pittsburgh record.

A. Oh, no, I didn't say that. My statement was that the general line of patents shown in the New York record was somewhat similar to the line of patents shown in the Pittsburgh record, and that I examined particularly the new ones, to see how they concerned this particular patent upon which we are contesting.

Q. You must have been careless then in your answer to Mr. Griffin's question, for in answer to his question, upon which I am now cross examining you, you testified that you found in the New York record an exemplification of everything shown in the Pittsburgh record, and the question I am now seeking to get an answer from you upon is where you find in the New York record an exemplification of the method of attachment shown in the Cummings patent on page 157 of the Pittsburgh record? Where do you find it?

A. I find it here. That is, in general; not exactly the same, but the general line of attachment, yes sir. Figure 7 only. I would say figure 7 of the Cummings patent No. 822587 on page 90 of the New York record and on page 167 of the Pittsburgh record I

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would say the same about that is I did about the other, that it is a type of a somewhat similar connection, namely, an attachment of the verticals by means of wire. It is not the same idea. If it was, you ought not to be able to patent it. It is a different patent.

I testified in the Pittsburgh case and have recently read my testimony in that case carefully. I found, I think, two mistakes in it.

Q. Now, the fundamental function of a proposition in column hooping construction, whether you use bands or a continuous coil, that is, a coil continuous in the direction of the spiral, is that the attachment shall be such so loose at the point of attachment, that the material can be fabricated, complete in the factory, and collapsed for economy of space in transportation, and then on the job restored to its form without substantial distortion of its form as originally produced in the factory, and with the bands or spirals, as the case may be, held in position so as to prevent substantial displacement, either longitudinally or laterally, during the course of pouring and ramming the concrete.

A. Yes sir. After the concrete is poured and is set, the concrete itself holds everything in position, and when the column is put under the compression strain of the load, the bands or coils resist the tendency to expand or diagonally shear or spawl off.

Q. While it would involve more trouble and work in the factory, being more expensive commercially, the use of an independent clip fastened around the

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column itself and then fastened around the coil or band sufficient to hold it,—as you use the term "rigidly" rigidly against longitudinal or lateral displacement to a substantial degree, would achieve the same functional purpose, would it not?

A. How would you do it?

Q. For instance, if it was done as is suggested by the clip method of attachment shown in figures 4, 5 and 6 of the Swiss patent to Mollins, 1903, shown on page 276 of the Pittsburgh record, such an attachment being of sufficient strength would accomplish the same functional purpose, would it not?

A. I would be afraid that it would be rammed down during construction. You understand that the workmen that handle this do not always handle it very carefully, and I do not see anything at all to prevent that clip being forced down to some extent by the process of depositing the concrete. You see there is nothing that holds that bar in position vertically but the friction between the two iron surfaces, and I doubt if that would be sufficient to keep it in place during the tamping of the concrete.

Q. Turning to figures 6, and 7 of the Cummings patent of 1906, shown on page 171 of the Pittsburgh record, where certain prongs of the clip are fastened independently to longitudinals and other prongs of the clip are used to embrace the coil or band. If those clips were fastened to the longitudinals sufficiently tight, they would hold the thing in place, would they not?

A. Well, if I was putting up a building myself,

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and I would be responsible for the safety of the folks that were in it, I would prefer not to use something that might be safe but something you would know when you put it in the concrete would stay there. None of these devices would be perfectly safe if there was carelessness in using them. The device of the prong and the cut in the spacing bars is about as fool-proof as you can get it. As a means of attachment I consider it perfect.

Q. Now in the art of column hooping long prior to the Vandenburgh patent there were disclosed a great variety of means of attachment, were there not?

Mr. Griffin: I object to the question unless it is shown definitely what counsel has in mind and what he refers to. The question is entirely too general and is irrelevant and immaterial.

(Question is repeated.)

Mr. Griffin: The question is further objected to on the grounds that it is not at all definite as to time.

A. I would not use the term "great variety." There was some variety. You understand that this patent came almost at the beginning of reinforced concrete construction; that in those days they did not take it up as much as they do now, and perhaps you might call 1900 the beginning practically of reinforced concrete construction. I would not say that there is a "great variety." There is some variety.

Q. Well, let the patents speak for themselves. Without regard to the patents particularly pertaining to column hooping as an entirely independent

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proposition, it was old at that time in metal working and engineering, wherever you had occasion to connect a transverse and a longitudinal member to connect it by tying it with wire, using a clip, using double interlaced longitudinals, so as to embrace the transverse members in the twisting of the longitudinals, as in the weaving of wire mesh, and wire cloth, and that sort of thing, or by welding or riveting, or by integral prongs or tongues punched out of a metal member, a longitudinal, or by cutting diagonal cuts into the longitudinal in some places, or by cutting right angle cuts into the diagonal and longitudinal and so forth, and for the engineer who was designing any particular thing for the purpose he had in view to adopt any particular one of those devices which he might consider the most desirable from a commercial standpoint, the expense of production, the convenience in assembly in the factory and field, the transportation, the rigidity that he desired to attain, etc., and to select such of those means as he preferred, was it not?

Mr. Griffin: The question is objected to as vague, too general and not referring to any issue offered under claims 1 and 3 in issue herein, and as being irrelevant and incompetent.

A. The methods were known that you speak of. Whether the engineer had a right to use them or whether they were available to be patented for specific cases is a question of law and I do not feel competent to answer.

Q. If you were an engineer and designing some-

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thing without regard to any patent law, you would select and use the one that appealed to you most from the standpoint of the problems you had before you, would you not?

A. But we engineers have to look out for patents just the same.

Q. You answer my question.

A. I am answering your question.

Q. No sir. I did not ask you to determine whether or not engineers must look out for patents. I asked you, assuming that there was no patent question involved. You can take that assumption for the purpose of your answer.

A. But we have to look out for patents. That is our instructions in specific cases.

Q. All right. You answer my question. Assuming that you did not have to look out for patents, then you could have selected any one of these that your judgment preferred?

A. Yes sir. That is we would pick out the one that was most suitable. In answer to a series of questions as to specific disclosures of Hyatt patent, witness agrees that, the Hyatt patent shown on page 189 of the Pittsburgh record shows a construction in figure 1 of spirals continuous in one direction with another set of spirals continuous in the other direction, from end to end, the spirals interlaced. In figure 4 he shows the use of a single spiral supported on a single longitudinal, and in figure 5 shows the adaptation of this construction to a solid column.

He says reading from printed page 191 of the

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Pittsburgh record "According to another plan I wind the metal strip or strips around a mandril, and make thus a long spiral closely or loosely coiled and of the length desired. To this coil I attach a tie properly fastened, and I then fill and overlay it with cement, concrete or their equivalents." He contemplates a continuous spiral closely or widely disposed as the engineer prefers. The spirals are to be held in position during the period of applying the concrete by a tie to which the coil is to be properly fastened.

Q. When he says "properly fastened" he means for the one who is making the construction to use such method of fastening as the constructor prefers, does he not, leaving it to his judgment?

Mr. Griffin: The question is objected to as the patent speaks for itself and no interpretation of it by this witness is necessary or required.

A. You will notice farther on in that same paragraph he says "beam." He applies this to a beam. Now, then, for a beam a proper fastening would not necessarily be an integral fastening. Most of those fastenings in practice are put in loose or just lightly wired. This question of properly fastened in this case would mean a lightly wired fastening. I don't see that has any bearing on this.

Q. Suppose the constructor preferred to rivet it on, would not the patent cover that?

A. I would not say that riveting was a proper fastening in that particular case. It is too expensive from a commercial aspect. The questions of ex-

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pense, convenience and function to be attained in each case control an engineer free to make a choice in the adoption of a particular choice. The virtue of the integral method of fastening spirals is its commercial possibilities, its ease of being shipped, to enable it to collapse, but it is rigid when they put it in the concrete and it is that wonderful practical part of it that makes this question worth fighting about.

Q. You consider you are engaged in a fight, do you? Answer the question.

A. This is a lawsuit. I would not consider riveting a proper method of attachment. It is too expensive and it weakens. Such a large proportion of the spiral is lost by the riveting. You take it in a three inch bar with three-quarter inch rivets, over 25% is lost by riveting, and it is that, together with the cost of the riveting, and the fact that if it is done in the field, it is done at a very large expense, and if it is done in the shop, it can not be collapsed for shipment ordinarily. Those two factors would prevent its commercial practicability.

Page 207 of the Pittsburgh record of Hyatt says in the final specifications "The tie c may be riveted, or otherwise attached to the metal sk.lton, as shown, and is preferably placed well up in the concrete to be out of the way of flame in case of being attacked by fire." I take it riveting has been used, but that system has not proven commercially able to compete with other systems. Hyatt evidently contemplated

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rivetting as one form of attaching his embracing spiral to his spacing tie.

Q. And would you not understand when he says it may be riveted or otherwise attached to the metal skeleton, that he meant that anybody constructing if they preferred not to rivet it for any reason, could attach it by any other means that were known in the art.

Mr. Griffin: The question is objected to as the patent speaks for itself and requires no interpretation on the part of this witness.

A. I will answer it as I did before, that he contemplated this for beam work, and for beam work wiring would be the proper method of attachment. Hyatt meant that he thought that a riveting attachment was the best way but that he left it open to attach the spiral to the tie in such a manner as the particular constructor preferred to select from the means available in the arts.

Q. Now, then, bearing that statement in mind, would you say that under the contemplation of Hyatt, and assuming that the method of attaching diagonals to longitudinals shown in the arts at the time of Hyatt then included the method of attachment shown by Norwood on page 282 of the Pittsburgh record, patent No. 571,575, is there any reason why a particular constructor, having the Hyatt patent before him, and preferring to select what he considered a proper method of attachment, or some attachment otherwise than riveting, would have had any difficulty in using the method of attachment

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shown in the Norwood patent? Of course, I understand that Norwood was not known at the time of Hyatt, but assuming that it was known at that time, would there have been any difficulty.

Mr. Griffin: The question is objected to as not directed to any issue of this case, and combination claims cannot be anticipated piece-meal.

Q. That is another question of law. We want the professor's opinion as a practical man, not as a lawyer.

A. It would not be practicable to connect the bar shown on page 218 of Hyatt's patent by the manner shown on page 282. It would be difficult to punch out. You could not punch out from a bar those holes, and unless you would punch them out it would be so expensive to drill them that the cost would be prohibitive. And furthermore, by the time you had punched out the holes for your tension bar, you would not have any strength left in it worth mentioning. No, it would not be a practicable method at all.

Referring to the tension bar page 218 Figure 2 and figure 4 of Hyatt is the same thing. That is, you see the hole would come right through there (indicating on patent) and the strength of your tension bar would be entirely gone. It would not be a practicable method at all. You would have to punch out the hole right through there (indicating on patent) and the hole would be so big that it would take up all the strength of your bar. Referring to figures 4 and 5 of Hyatt and considering the size of spiral there shown.

(Testimony of Horace R. Thayer.)

Q. Related to the size of the longitudinal or what he calls the tie c there shown, you could not punch out in c enough of an opening to hold the spiral a, according to the method of Norwood without destroying the small tie-rod?

A. No. It is evident that the patentee Hyatt never had in mind such means of fastening as you have mentioned. I will repeat what I said before, that for a beam that Hyatt has got his patent on, this method of punching out will be impracticable for the reinforcement shown. It would take away too much of the strength of the member, and he probably did not contemplate it. That is, I should say as an engineer, if he had enginering sense he would not have contemplated the use of the prong in connection with his construction.

Q. Won't you please answer a single question once in a while directly so that I may proceed in a constructive way to the point I want to ultimately reach. Now, won't you please answer this one question—If the proportion, the relative sizes, of the two members shown in Hyatt's Fig. 4 were such that the tie rod c was large enough to afford space without destruction of necessary strength in tension and the spiral A was small enough to be incorporated in such space as might safely be cut out of the longitudinal tie rod, could not an engineer who knew of the Norwood construction, at Page 282, have adapted that to the Hyatt patent if he had so desired?

A. Not to make a practical construction—because it would take away too large a proportion of the ten-

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sile strength of the member C which is relied on to carry the stresses. The proportion lost is too large to make it practicable. It would not be practicable if the members are altered in size as you suggest. I think I read Considere several years ago. I do not remember any disagreements with his conclusions. His record has been accepted as very valuable. I am familiar with the works of Prof. Hool—also with the books of Thompson & Taylor and Turneaure & Maurer. They are the three leading works on this subject. Prof. Turneaure stands very high in the profession. I do not know how much practical experience he has, but in the matter of testing and theoretical work I should judge from his book that he has not had much practical experience. He is very high theoretically. I would say he is among the best.

Q. Now in this matter of column hooping, the functions in column hooping construction, the problems to be met and solved are functionally different from those involved in beam construction, I should understand from what you say in reference to Hyatt and his being a beam construction?

A. Yes sir, very different. Nevertheless a beam may be used as a column, but it would not be practicable in most cases—or desirable. If heavy and strong enough it would be practicable excepting from a commercial standpoint. In American practice my recollection is both longitudinal reinforcement and hooping came in together as alternative types, but the hooping was discovered a long time ago and be

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fore concrete came in general use, so that the two came into use sort of together in America. I was not in touch with practical construction at that time, but I take it I have been in touch with the beginnings of reinforced concrete in this country and I know they came in both together. There was a common type where the longitudinal reinforcement was of such area as to itself serve to extend resistance to compression and serve as a member of that kind although its main function is to carry the sidewise bending that occurs when a column is put in action, more particularly a long column. This is accomplished by having oppositely opposed longitudinals near the circumference or corners, if the column is square. They put the reinforcement on the outside of the column. They had opposing longitudinal members which worked one in one direction and another in another.

Q. Would you get any substantial, calculable results in a column of say eighteen inches in diameter by the use of a couple of longitudinals having a sectional area of say three-sixteenths of an inch?

A. It would not amount to very much. It would be small. It would not be worth figuring. Unless they were properly put in position and properly stayed, they would be worthless because they would buckle on a load, probably buckle at a lower load than though it was without. It might really be a detriment. They would serve no substantial function except as a spacer for the spirals. I understand that there is no substanial functional difference in the re-

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sult produced in column hooping between the use of bands or independent loops spaced parallel on the longitudinals, and a coiled spiral similarly spaced, provided the coils of the spiral are sufficiently close together to correspond in the distance between each spiral with the distance between the bands; and if either the bands or the spiral loops are too far apart that the intervening space not protected against expansion provides the same weakness in the column as if some spiral was shoved up. The weakest point determines the strength of the column as a whole. The proper spiral spacing should be about, I should judge, one-sixth of the diameter. A wider spacing than that would not measure up to a practicable and safe device for the purpose. That is the standard. We would allow some variation, but that is the standard engineers have set. One-fourth of the diameter of the spiral would be a little doubtful. One-half would be too much. The concrete would fall off. I think one-fourth would be risky. I would not want to attempt it myself.

Q. Now in discussing this Hyatt patent, and the question of the application of the Norwood method you emphasized the proposition that the application of Norwood to that was impracticable, because the tie rod of Hyatt as compared with the spiral of Hyatt would not permit a sufficiently deep kerf in the tie bar?

A. Yes, but I would say that a design such as Vandenburgh's Fig. 1, showing a spacing between the spirals of practically one half of the diameter

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of the spirals would be about the right spacing of the hoops for a beam. However, I do not think that the Vandenburgh patent for beams would have great practical value for just the very objection I raised against the Hyatt patent, that is the kerf that has to be cut in the tensile member, because for beam purposes and as a longitudinal member in beams, the longitudinal member is the principal member resisting the strain of tension on that side of the beam.

Q. And the other members running up diagonally into the concrete, whether they be a single rod or loops or double loops or single loops or whatever device it is, is only, we will say, for three purposes: First, to transmit from the concrete into the longitudinal members the stresses in the body of the concrete. Second, to prevent that diagonal shear at right angles or substantially at right angles to the line of this subsidiary reinforcement which takes place or tends to take place in a concrete beam when strained under load. And third, by considering or treating the diagonal members oppositely extending from the center toward the ends of the beams as part of the members of a truss, the web members, and the longitudinal reinforcement as the lower chord and the compressive strength resistance of the concrete above as the upper chord, to produce a truss action and resist the load in that way.

A. In the main I agree with your statement. There are two points I might differ on. In the first place, these pieces extending out from the beam should be at an angle of forty-five degrees. You

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did not mention any angle. That shear acts at an angle of forty-five degrees. In the second place, I would think the second and third purposes you have mentioned were practically the same thing. Otherwise, I agree with you entirely.

Q. The second and third amount to the same thing?

A. Amount to the same thing.

Q. Just a different way of describing it?

A. Just a different way of describing it. Practically I agree with you entirely.

Q. Now, all of those purposes in a beam require, that the subsidiary incidental members run at an angle of about forty-five degrees?

A. Yes sir.

Q. And oppositely from the center?

A. Yes; they get their greatest efficiency if they run forty-five degrees. They are sometimes run vertically.

Q. That is what the original and still continued use known as stirrups was?

A. Yes sir.

Q. Where they wire the small transverse member to the rod at the side of the beam?

A. Yes sir. Stirrups are still used a great deal, vertical stirrups.

Q. They are easier to apply but do not have the same efficiency?

A. Not as efficient. Commercially, they can be put in for a lower price per pound.

Q. Now, in this connection, Professor, I call your

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attention to the Defendant's Exhibit 7, a piece of rectangular iron with kerfs cut in it, and which we are told in the testimony was used as the longitudinal in a beam construction at Washington. The amount of metal in a member of the kind shown in Exhibit 7 would be determined by the depth and transverse section of the beam in which it was used, thereby determining the amount of compressive strength of the concrete you have got above it, and both applied to the load that you wanted the beam to carry, each its own weight and whatever weight would be superimposed upon it in use. Those would be the determining factors in fixing the amount of metal, assuming a given tensile strength in area.

A. Not exactly.

Q. What else?

A. The amount of area that should be in a beam is a certain percentage of the area of the beam, depending upon the allowable fibre stresses that you have. Now, your statement is wrong in one respect. You might figure out the amount of steel you would require in a beam but your concrete might be over-stressed, that is, a well proportioned beam has got a certain amount of steel for every square inch of concrete and then it will carry a certain amount of load, and if that load is exceeded both the steel and the concrete are over-stressed.

Q. Perhaps I was assuming that we all knew a little more about concrete and concrete construction or reinforcement than is disclosed in the record. I will start at the fundamentals. The perfect con-

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struction of a reinforced concrete beam would be one in which the metal at the bottom would resist a stress in extension exactly equal to the stress in compression that was afforded by the concrete of the particular mix used in the beam.

A. Yes sir, that is correct.

Q. To have more steel to resist tension than you could develop in the concrete in compression would be a waste of steel?

A. Yes sir.

Q. And more concrete than is required to offset the steel would be a waste?

A. Yes sir.

Q. And the engineers endeavor to balance those two factors as closely as they can with the materials conveniently available?

A. Yes sir.

Q. Now, in explaining to me about the amount of concrete in the beam opposed to the steel, I believe you said it is not merely a question of the amount of concrete in the beam but is a question of the amount of concrete referred to the depth of the steel from the top of the concrete?

A. No. I think you are wrong about that. I take it there is a certain percentage—

Q. I will put it another way. If you had thirty-six square inches of concrete in sectional area above the center of gravity of your steel, that is, the center of the steel rod, and that thirty-six inches consisted of a beam that was nine inches wide and four inches deep, it would not have the same compressive

(Testimony of Horace R. Thayer.)

strength as if it was a beam that was only six inches wide and six inches deep about the center of gravity. —That is a beam, in which the concrete, of the same actual amount of concrete, was greater in depth and narrower in width, would have more compressive resistance than if the beam was one where the same concrete was shallow in depth and broad in width.

A. Exactly, but the same area requires the same percentage of steel, nevertheless that is to say, if you had thirty six square inches, it would have to be reinforced by the same amount of steel, to get the full efficiency, whether it was a six by six or four by nine. That is we take the depth as the distance from the top of the beam down to the center of gravity of the steel in all cases. That is, the six inches in depth would be measured from the top of the beam down to the center of the steel. —Take what is known as a balanced ratio under the Pittsburgh Building Code, with which I am familiar and under which I have done a good deal of designing. That balanced ratio is seventy-five one-hundredths of one percent. That would mean for thirty six square inches of concrete we would put in .27 of a square inch of steel and that would develop the steel and the concrete, and when you have sixteen thousand pounds every square inch in your steel, you have six hundred and fifty pounds very square inch in your concrete, no matter in what form you put your beam. If you set an ordinary oak plank two inches thick and eighteen inches wide, and say sixteen feet long on edge it will support a great deal bigger load than it would if it

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lay flat on its side. In a reinforced concrete beam the steel on one side and the concrete on the other do what the wood in a wooden plank does on both sides. The load would be very much decreased with this eighteen by two inch beam, you speak of, but the two would fail together. That is, the steel and the concrete would fail together, provided they put the economic ratio in.

Q. This Exhibit 7 shows a longitudinal rod, and the testimony shows that it was used in beam construction, and that the diagonal kerfs shown in it were oppositely opposed from the center of the beam from which this piece was cut as a section. Now using diagonals spaced as these were and assuming that the direction of the diagonal running up into the concrete as indicated by the kerfs was about forty-five degrees each way from the center would the size of these kerfs admit of steel of sufficient size for the diagonals?

A. Yes, I would say, off-hand for the size that the steel is it would be about right. If two loops were used they might put one on top of the other. If placed side by side, I would think that the stirrups of the loops, as you call them, would be getting a little small. Those small wires would suffice because the bar exhibited here is the thing, it is the real thing, to be considered in a beam. In a column it would not make any difference how big this bar was as long as it was big enough to hold the spiral in place while the concrete was being poured and tamped? The bar covers some stress, although in practice we

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use for spacing bars light bars and generally omit them in figuring. It is felt that the spacing bars are so light that they are not worth figuring, as you spoke about some time ago. You use them as light as you can in order to save metal in the spacing bars, because they are not figured and we want to save as much as we can. We make them as small as we can and to support the spirals in position.

Q. Now, coming to Vandenburgh's Fig. 6, the device which he indicates as the one adapted to columnar construction, would you say as a practical man that with double loops on spacing bars oppositely opposed and intermeshed in that way, set up inside of a form for the purpose of pouring concrete in, and with somebody ten feet up above, as you have illustrated in reference to Hyatt, pouring the concrete in and tamping it in so as to get it solidly tamped around and in contact with the reinforcement at all points, would be practicable to use?

(Pages omitted in narrative reduction.)

(Testimony of Horace R. Thayer.)

of attachment to the Hyatt design in Fig. 4, you have considerably emphasized the proposition that the application of Norwood to that was impracticable because the tie rod of Hyatt as compared with the spiral of Hyatt would not permit a sufficiently deep kerf in the tie bar?

A. Yes.

Q. Now, examining the Vandenburgh patent in suit by the same rule of comparison of relative dimensions, would you say that a design such as Vandenburgh's Fig. 1, showing a spacing between the spirals of practically one half of the diameter of the spirals would be a practicable construction for columnar purposes?

MR. GRIFFIN: The question is objected to, as Fig. 1 is not an issue in this case, and upon the further ground that it is well understood that patent office drawings are not made to scale.

MR. GUTHRIE: I thought that was true when I was asking about Hyatt. Answer the question.

A. Fig. 1 is a beam, and I would say roughly that he had shown about the right spacing of the hoops for a beam. However, I do not think that the Vandenburgh patent for beams would have great practical value, for just the very objection I raised against the Hyatt patent.

Q. What is that?

A. That is the kerf that has to be cut in the tensile members.

Q. That is because for beam purposes and as a longitudinal member in beams, the longitudinal

(Testimony of Horace R. Thayer.)

member is the principal member resisting the strain of tension on that side of the beam.

A. Exactly, yes sir.

Q. And the other members running up diagonally into the concrete, whether they be a single rod or loops or double loops or single loops or whatever device it is, is only, we will say, for three purposes: First, to transmit from the concrete into the longitudinal members the stresses in the body of the concrete. Second, to prevent that diagonal shear at right angles or substantially at right angles to the line of this subsidiary reinforcement which takes place or tends to take place in a concrete beam when strained under load. And third, by considering or treating the diagonal members oppositely extending from the center toward the ends of the beams as part of the members of a truss, the web members, and the longitudinal reinforcement as the lower chord and the compressive strength resistance of the concrete above as the upper chord, to produce a truss action and resist the load in that way.

A. In the main I agree with your statement. There are two points I might differ on. In the first place, these pieces extending out from the beam should be at an angle of forty-five degrees. You did not mention any angle. That shear acts at an angle of forty-five degrees. In the second place, I would think the second and third purposes you have mentioned were practically the same thing. Otherwise, I agree with you entirely.

(Testimony of Horace R. Thayer.)

Q. The second and third amount to the same thing?

A. Amount to the same thing.

Q. Just a different way of describing it?

A. Just a different way of describing it. Practically I agree with you entirely.

Q. Now, all of those purposes in a beam require that the subsidiary incidental members run at an angle of about forty-five degrees?

A. Yes sir.

Q. And oppositely from the center?

A. Yes; they get their greatest efficiency if they run forty-five degrees. They are sometimes run vertically.

Q. That is what the original and still continued use known as stirrups was?

A. Yes sir.

Q. Where they wire the small transverse member to the rod at the side of the beam?

A. Yes sir. Stirrups are still used a great deal, vertical stirrups.

Q. They are easier to apply but do not have the same efficiency?

A. Not as efficient. Commercially, they can be put in for a lower price per pound.

Q. Now, in this connection, Professor, I call your attention to the Defendant's Exhibit 7, a piece of rectangular iron with kerfs cut in it, and which we are told in the testimony was used as the longitudinal in a beam construction at Washington. The amount of metal in a member of the kind shown in

(Testimony of Horace R. Thayer.)

Exhibit 7 would be determined by the depth and transverse section of the beam in which it was used, thereby determining the amount of compressive strength of the concrete you have got above it, and both applied to the load that you wanted the beam to carry, each its own weight and whatever weight would be superimposed upon it in use. Those would be the determining factors in fixing the amount of metal, assuming a given tensile strength in area.

A. Not exactly.

Q. What else?

A. The amount of area that should be in a beam is a certain percentage of the area of the beam, depending upon the allowable fibre stresses that you have. Now, your statement is wrong in one respect. You might figure out the amount of steel you would require in a beam but your concrete might be over-stressed, that is, a well-proportioned beam has got a certain amount of steel for every square inch of concrete and then it will carry a certain amount of load, and if that load is exceeded both the steel and the concrete are over-stressed.

Q. Perhaps I was assuming that we all knew a little more about concrete and concrete construction or reinforcement than is disclosed in the record. I will start at the fundamentals. The perfect construction of a reinforced concrete beam would be one in which the metal at the bottom would resist a stress in extension exactly equal to the stress in compression that was afforded by the concrete of the particular mix used in the beam.

(Testimony of Horace R. Thayer.)

A. Yes sir, that is correct.

Q. To have more steel to resist tension than you could develop in the concrete in compression would be a waste of steel?

A. Yes sir.

Q. And more concrete than is required to offset the steel would be a waste?

A. Yes sir.

Q. And the engineers endeavor to balance those two factors as closely as they can with the materials conveniently available?

A. Yes sir.

Q. Now, in explaining to me about the amount of concrete in the beam opposed to the steel, I believe you said it is not merely a question of the amount of concrete in the beam but is a question of the amount of concrete referred to the depth of the steel from the top of the concrete?

A. No. I think you are wrong about that. I take it there is a certain percentage—

Q. I will put it in another way. If you had thirty-six square inches of concrete in sectional area above the center of gravity of your steel, that is, the center of the steel rod, and that thirty-six inches consisted of a beam that was nine inches wide and four inches deep, it would not have the same compressive strength as if it was a beam that was only six inches wide and six inches deep above the center of gravity.

MR. GRIFFIN: This line of cross examination is objected to upon the ground that particular de-

(Testimony of Horace R. Thayer.)

signs of beams or columns are not in issue in this case.

MR. GUTHRIE: I am only asking the questions so that the professor and I may get into accord as to the preliminaries before I come down to the real questions.

THE WITNESS: Let me have those dimensions.

Q. That is, a beam in which the concrete, of the same actual amount of concrete, was greater in depth and narrower in width, would have more compressive resistance than if the beam was one where the same concrete was shallow in depth and broad in width.

A. Exactly, but the same area requires the same percentage of steel, nevertheless; that is to say, if you had thirty six square inches, it would have to be reinforced by the same amount of steel, to get the full efficiency, whether it was a six by six or four by nine. That is, we take the depth as the distance from the top of the beam down to the center of gravity of the steel in all cases. That is, the six inches in depth would be measured from the top of the beam down to the center of the steel.

Q. Let us get facts to start with about which there is no disagreement. Assuming a beam twenty feet long to support its own dead weight and a live load of one hundred pounds per square foot, how much steel would you require before we come to the question of concrete?

A. I would have to take and figure that out. Furthermore, you have not given me the spacing of your

(Testimony of Horace R. Thayer.)

beams. I would have to have that, and it would take me an hour or so without a set table.

Q. We will assume thirty six square inches of concrete in section above the center of gravity of the steel.

A. Yes sir.

Q. And we will assume that the depth of that concrete above the center of gravity of the steel is only two inches, and that the width of the concrete to develop thirty six square inches was eighteen inches.

A. Yes sir.

Q. Now, that concrete would crush under a load before it developed the tensile strength of a steel rod of a much smaller size than if the beam was nine inches deep and four inchs wide. Now, I know that it takes the same steel in area to develop the same strength as against a certain amount of compressive strength, but if the same amount of concrete is only two inches deep above the steel, the concrete itself would give way before it developed the steel to a point which a depth of nine inches and four inches in width would develop?

A. I cannot agree with you there.

Q. You do not seem to agree with any authority on the subject.

A. I would like to hear of any authority that disagreed with me.

Q. I haven't a bunch of books here, but I might get you a few. Look it up when you get home.

A. I do not care about looking it up. Take what

(Testimony of Horace R. Thayer.)

is known as a balanced ratio under the Pittsburgh Building Code, with which I am familiar and under which I have done a good deal of designing. That balanced ratio is seventy-five one-hundredths of one percent. That would mean for thirty six square inches of concrete we would put in .27 of a square inch of steel and that would develop the steel and the concrete, and when you have sixteen thousand pounds every square inch in your steel, you have six hundred and fifty pounds every square inch in your concrete, no matter in what form you put your beam.

Q. Let me be fair, professor. Take a simple illustration. Take an ordinary oak plank two inches thick and eighteen inches wide, and say sixteen feet long. Now, if that is used as a beam the bottom of the wood furnishes the tensional resistance, and the upper part of the board furnishes the compressive resistance, does it not?

A. Yes sir.

Q. Now, if you would set that beam on its two inch edge it would support a great deal bigger load than it would if you would lay it flat on its side, would it not?

A. Yes sir.

MR. GRIFFIN: I object to the question on the ground it is immaterial to any issue in this case.

Q. Now, in a reinforced concrete beam the steel on one side and the concrete on the other do what the wood in a wooden plank does on both sides?

A. Yes. The load would be very much decreased

(Testimony of Horace R. Thayer.)

with this eighteen by two inch beam you speak of, but the two would fail together. That is, the steel and the concrete would fail together, provided they put the economic ratio in.

Q. All right. I think that will bring us back to this Exhibit 7. This Exhibit 7 shows a longitudinal rod, and the testimony shows that it was used in beam construction, and that the little diagonal kerfs shown in it were oppositely opposed from the center of the beam from which this piece was cut as a section. Now, using diagonals spaced as these were and assuming that the direction of the diagonal running up into the concrete as indicated by the kerfs was about forty five degrees each way from the center?

A. Yes.

Q. And that a loop diagonal after the method of the Vandenburgh Fig. I or Fig. 4, of either a single coil or a double coil, was used, would it be your judgment as an engineer that the size of this kerf would admit of the inclusion of this small incidental diagonal of a sufficient size to serve the purpose?

A. I would say offhand for the size that the steel is it would be about right.

Q. If two loops were used, they would have to be about half the size or less than one half the size of a single loop so as to get into this kerf?

A. They might put one on top of the other possibly. If two loops were used and placed side by side, I would think that the stirrups of the loops, as you call them, would be getting a little small.

Q. Those small wires would suffice because this

(Testimony of Horace R. Thayer.)

bar exhibited here is the thing, it is the real thing, the primary fundamental thing to be considered.

A. That is in a beam, yes.

Q. Whereas in a column it would not make any difference how big this bar was as long as it was big enough to hold the spiral in place while the concrete was being poured and tamped?

A. Yes, the bar covers some stress, although in practice we use for spacing bars light bars and generally omit them in figuring.

Q. That is, to save as much metal as you can where it is not needed?

A. You take it, it is felt that the spacing bars are so light that they are not worth figuring, as you spoke about some time ago.

Q. That is, you use them as light as you can in order to save metal in the spacing bars?

A. Yes, because they are not figured and we want to save as much as we can. We make them as small as we can and to support the spirals in position.

Q. Now, coming to Vandenburgh's Fig. 6, the device which he indicates as the one adapted to columnar construction, would you say as a practical man that with double loops on spacing bars oppositely opposed and intermeshed in that way, set up inside of a form for the purpose of pouring concrete in, and with somebody ten feet up above, as you have illustrated in reference to Hyatt, pouring the concrete in and tamping it in so as to get it solidly tamped around and in contact with the reinforcement at all points, would be practicable to use?

(Testimony of Horace R. Thayer.)

A. I would say it would work, but, as you say, it would not be practicable because we have got better methods of doing it.

Q. Would you agree with Considere in his statement incorporated in the record and which you heard read, that it is essential to leave in the core of the column sufficient open space to let the concrete flow freely and be tamped in so as to come in contact all around?

A. Yes sir, I would agree with him.

Q. Now, turning to this Fig. 4 of Vandenburgh's, and assuming that it does pertain to columnar construction as a separate unit, not used as in Fig. 6, but used independently, would you say as an engineer that it would suggest to you columnar construction, considering the spacing of the spirals with reference to their diameter?

A. I don't quite understand the question.

(Question read)

A. If you consider the cut to scale, I would think that the spacing of the spirals ought to be closer, that is, from tests which we have gotten out.

Q. It would not suggest a spiral as pictured in the Figure because it would show a spacing that, while properly adjusted to beam construction, would not be properly adapted to columnar construction with that spacing.

A. That spacing is shown as about one-third the diameter. It ought to be closer, that is all. It is about the right type of columnar construction, but the spacing needs to be closer.

(Testimony of Horace R. Thayer.)

Q. Now, take your copy of this patent. I want to call your attention carefully to certain parts of the description.

A. The original, or the re-issue?

Q. They are both the same. Either will do. Now, it says, commencing at line 42 of the first page, that, "The numeral 1 designates a bar which may be of any desired construction or configuration and supported in any preferred manner". That means to you that Fig. I is for beam construction solely?

A. Well, no. No. I is shown in Fig. 4 also, also in Fig. 6.

Q. Just leave Fig. 4 out. Take Fig. 1. That would not be adapted to columnar construction, where the obliquity of the incidental spirals is oppositely oposed to the center?

A. Fig. 1 is given here to, and also given there (indicating on patent)

Q. Fig. 1 does not refer to the numeral 1. I mean the figure 6 now?

A. But in line 42 it says, "The numeral 1 designates a bar."

Q. That is the numeral 1 designating the longitudinal bar in all the figures. My question now is directed to Fig. 1 as a whole, without reference to numeral 1, designating the main bar.

A. That is, you wanted me to explain lines 42 to 45?

Q. No. Put that aside for a moment. Omit numeral 1 altogether for the present. Fig. 1 would indicate purely a beam construction, would it not?

(Testimony of Horace R. Thayer.)

A. Yes sir.

MR. GRIFFIN: The question is objected to as Fig. 1 is not in issue in this case.

A. (continuing) Although it might be used as a column, but it would not be a well designed column.

Q. And it would not be the equivalent of the continuous coil in column hooping?

A. Not as good, no.

Q. Now, turning to line 29, it says there: "In the drawings, Figure 1 is a vertical section showing the bar applied to supporting girders or beams." Now, you understand that means the bar construction as a whole; do you not?

A. Yes sir.

Q. Then it goes on to say, "Fig. 2 is an enlarged vertical section on the line 2-2, Fig. 1." That you would regard as a detail showing how Fig. 1 would look if you looked at the end of it down through the [illegible]

A. Yes, or section. It is a section through the middle. Practically the same thing.

Q. Then it goes on to say: "Fig. 3 is a detail in perspective of the primary and secondary coils shown in Fig. 1." Would you understand that detail to give you merely a clearer view of how the double coils in Fig. 1 run, one coil from one end of the bar to the other, reversing in the middle, and the other coil from the other end of the bar to the first end, reversing in the middle?

A. Yes.

(Testimony of Horace R. Thayer.)

Q. That is, it is only, like Fig. 2, a detail showing part of Fig. 1 more clearly?

A. Yes sir.

Q. Now, it goes on to say: "Fig. 4 is a similar view of a modified form using one coil." Now, when he states that Fig. 4 is similar to Fig. 1 except that it shows a modified form of Fig. 1, while there is only one coil instead of two, would you not understand that, with the explanation of Fig. 3, which you have already explained, represents a mere detail and that Fig. 4 as a similar view showed the same kind of a detail with the change only in respect to using one coil instead of two?

MR. GRIFFIN: Question is objected to, as this patent speaks for itself and requires no explanation by this witness.

A. Well, of course, I would rather assume that in a method of construction like this, that it would not prevent alteration of certain dimensions if the designer saw fit to make them.

Q. I understand that an engineer can get an idea and develop it, but what I want to ask you as an expert who has been asked to construe these patents and explain them, to tell the court what they meant, is whether or not you would say that when Fig. 3 is, as you have stated, specifically, a mere detail of part of Fig. 1, using two coils, and Fig. 4 is said to be a similar view, similar to Fig. 1, representing the same part of the bar as Fig. 1 but modified only in respect to using one coil instead of two, that the

(Testimony of Horace R. Thayer.)

description meant that Fig. 4 was to illustrate a detail of a part of the bar shown in Fig. 1.

MR. GRIFFIN: The same objection.

A. It shows the method of construction. You take it if I was asked to design a beam of the Vandenburgh patent, all these details would be figured out, the size of the rods, and the spacing of the rods, the rods would be increased as the spacing gets greater in the middle than it is at the ends, or if the spacing is made less in the ends, or if I put one coil in instead of two, the spacing would be made one half as great, and I would consider it all the way through. You take it in our design work, we not only would figure out the size of the coils, we might go as far as to figure the size of the kerfs.

Q. I am afraid you do not understand me. The point upon which I am asking your opinion is this: That when you read this patent and when the patent says, and you say that it says, that Fig. 3 is a detail intended to represent in detail, as other details do, but a part, not the whole of a bar, and when Fig. 4 is stated to be a similar view with a modification in respect to the omission of one coil, if Fig. 4 is not intended to represent a detail or part of a bar and not intended to represent a complete bar in itself.

MR. GRIFFIN: The question is objected to, as Fig. 4 speaks for itself, and the patent speaks for itself, and is its own explanation, and does not require explanation by this witness.

A. I would say that it is a detail of it, but I would think that the individual measurements

(Testimony of Horace R. Thayer.)

might be varied; that is, I would not think that necessarily the spacing between the kerfs need be the same, in this case that they are in this, in the case of Fig. 4, as they are in Fig. 3. That would be a matter for the designer and would depend upon the loads to which they would be subject.

Q. Now, I want to come to an entirely different proposition. In this Vandenburgh patent, calling your attention now to the part of the description commencing at line 16, page 1; "The invention has for an object to provide a reinforcing bar with one or more spirally-disposed coils secured to the bar so as to provide an extended area of contact adapted to resist strain longitudinally and laterally of the bar, and to form a truss within the body of concrete or other plastic material which provides the maximum of suporting strength in the arch or surface to be formed." You would not say that the object of the invention which Vandenburgh claims to have made was to provide a truss action?

MR. GRIFFIN: The question is objected to as the patent speaks for itself.

A. Of course, I cannot tell what Vandenburgh had in his mind at the time he wrote this patent, but a truss action occurs in a column just the same as it does in a beam, so that I do not think it would be vital.

Q. The truss action—

A. Yes sir.

Q. —would not occur unless the minor subsidiary diagonals were extended in opposite directions from

(Testimony of Horace R. Thayer.)

the center, would it?

A. Well, with concrete they ought to be extended in opposite directions from the center. The truss action would occur anyway, but they would not be efficient in resisting that truss action unless they extended in opposite directions to the center.

Q. Now then, turning to line 65 of the patent, where it says: "thus providing a construction in which all lateral pull or strain of the coil is avoided, owing to the equalization thereof by the oppositely-extending coils, and the tendency of the coils to move or flatten toward the face of the bar resisted." Would you interpret that to accomplish this result of equalizing the lateral pull or strain it would be necessary to have the coils oppositely extended from the center?

A. I could not agree with him on that. I do not see how you can have the pull or strain on the coils.

Q. He does not avoid it. He seeks to equalize it, he says.

A. He says: "thus providing a construction in which all lateral pull or strain of the coil is avoided."

Q. "Owing to"—

A. It says: "is avoided, owing to the equalization" I do not see how he can avoid it.

Q. There would be no tendency in that direction unless they were oppositely extended, would there?

A. I do not agree with him on his analysis of that.

Q. He says that it is desirable that both the coils,

(Testimony of Horace R. Thayer.)

that is, the two coils used, be deflected away from the center of the bar. Is that desirable to accomplish the purpose of this construction?

MR. GRIFFIN: The question is objected to as relating to matter not in issue in this case.

A. It is desirable to point them as shown in Fig. 1, away from the center of the beam, even in a column.

Q. Then all of this column hooping, where the coil runs in one continuous direction without reversal from the center, is wrong, is it?

A. No. That action is a different matter entirely. The theory of beam action and the theory of hoop columns is entirely different. If you were going to reinforce it to carry as a beam, you would reinforce it one way. If you were going to reinforce it as a hooping, you would reinforce it another.

Q. Do you agree with Vandenburgh that the tendency of a weight upon his construction would be to draw these coils upward into a position at right angles to the bar? Not that it would accomplish it, of course, in a solid mass of concrete, but that the tendency would be in that direction?

A. I would not think so. It would to a certain limited extent possibly, a very limited extent.

Q. It would not do it to any extent if the coils was a single continuous coil running in the same direction of spiral on both sides of the center?

A. No. I cannot agree with him as to his idea of the action of the beam or column under stress.

Q. I asked you if we assume that the column

(Testimony of Horace R. Thayer.)

hooping construction, where the spiral runs continuously in a single direction without changing its center, were used, whether there would be any tendency at all to draw the coils upward at right angles?

A. The coils are practically at right angles already.

Q. I mean the column hooping construction, where the coils are oblique.

A. I do not see that they would change in their position at all to be worth mentioning. There might be a slight tendency to change them.

Q. Now, turning to line 80 of page 1, where Vandenburgh says that: "As a preferred means of securing the coils to the bar I have shown a series of kerfs 8 in one face of the bar inclined away from the center of the bar toward the opposite ends thereof." Reading this patent, do you understand that Vandenburgh intended to confine himself to the kerf as a means of affixation any more than Hyatt confined himself to the riveting as a means of affixation, or that Vandenburgh preferred the kerf as his means as Hyatt preferred the rivet as his means, but each leaving himself to adopt any means desired?

MR. GRIFFIN: Objection is made to the question upon the ground that the patent speaks for itself, and requires no explanation by this witness.

A. My understanding is that Vandenburgh laid a great deal of stress on that kerf all the way through, the integral means of securing the bar.

Q. I agree with you because of his statement that

(Testimony of Horace R. Thayer.)

the kerf is a preferred means, but I am asking you as an expert interpreter of this patent, whether you consider that Vandenburgh intended to limit himself to kerfs or whether he only recommended the kerf as the preferred means of securing the coil.

MR. GRIFFIN: The same objection, and besides that the further objection that the claims determine the issue and not the specifications of the patent.

A. Well, it is the only method that he speaks of. He calls it a preferred means, and some of his claims are based entirely on the kerfs. He uses the term "integral" in places, and at the time that he got out this patent I do not know of any method that he could have had in mind that would have integrally secured it except that of the kerfs. Of course, now we have electric welding, but I think he must have had that largely in mind as the means.

Q. The question is, do you, as an expert, think he intended to limit himself to kerfs as against any other method that he might himself or somebody else might themselves later prefer to use?

MR. GRIFFIN: The same objection.

A. I should judge from my reading it over that he had kerfs in mind, but that he wanted to leave it open if he could get any other way. He probably had the kerfs in mind, because he has shown them all the way through his cuts.

Q. That puts us in perfect accord, professor, and we will proceed. Now, you turned to the claims a moment ago. Do you understand it to be the rule

(Testimony of Horace R. Thayer.)

of the construction of claims in a patent that the description is intended not only to support the claims but that the description may be referred to, taking the patent as a whole, for the purpose of understanding the sense in which any particular language not otherwise entirely clear in the claims was intended to be used in the claims?

MR. GRIFFIN: I object to the question upon the ground that that is a proper subject matter for the court to consider and that it is entirely irrelevant and immaterial.

A. I am not an expert on that matter. I only understand about drafting and things like that. I would think that the drawings and descriptive matter would have about equal weight.

Q. Now, then, turning to claim 3, for instance, where he uses the term "kerfs", without describing kerfs any more than the mere use of the term, then turning back to line 82 of page 1 of the patent, where he speaks of his kerfs as a "series of kerfs in one face of the bar inclined away from the center of the bar toward the opposite ends thereof," what would you say as to whether, as you understand it, in reading claim 3, he meant by the use of the term "kerf", the kind of kerf which is described in his description?

MR. GRIFFIN: I object to the question, as the patent speaks for itself and requires no explanation from this witness, and further, it is a matter of interpretation for the court.

A. Well, I would think this, that in lines 80 to

(Testimony of Horace R. Thayer.)

85 he says he has shown a "series of kerfs inclined away from the center of the bar toward the opposite ends thereof." He is speaking then of what he has shown. In claim 3 he is claiming all kerfs. I would think that he claimed all kerfs but he showed in this particular one the style of kerf that was most suitable for the beam, in which I would agree with him, that is, that it is the most suitable kerf for the beam.

(Noon adjournment)

Q. I understood you to testify, in answer to a question by Mr. Griffin that the method of attachment of the spiral to the spacing bar shown in Defendant's Exhibit No. 1 was the same in general type of action as that shown in the Vandenburgh patent in suit?

A. Yes, sir.

Q. You mean by that they are substantially the same?

A. That is, they fasten integrally by means of a kerf to the spirals.

Q. That Exhibit 1 shows, first, a rectangular cut?

A. Yes.

Q. In the lower part of the T member?

A. Yes.

Q. While Vandenburgh shows a diagonal cut in a flat member?

A. Yes, sir.

Q. They differ in that respect?

A. They differ in that respect, yes, sir.

Q. Exhibit 1 shows a kerf originally with no pro-

(Testimony of Horace R. Thayer.)

jecting prong over the encircling rod as orginally inserted, while the Vandenburgh patent would show a projection over the rod before it was originally inserted and before it was pounded down?

A. Yes, sir.

Q. Exhibit No. 1 shows the encircling spiral held in place in the rectangular cut by creating an overlapped member by peening or cutting down into the bar so as to shift or move a portion of the metal of the bar over the spiral?

A. Yes, sir.

Q. While the Vandenburgh patent shows that the embracement is completed simply by bending the already overlapping spur down so as to close the opening?

A. Yes sir.

Q. Now, you regard those as substantially the same thing in engineering?

A. Yes; I would call it a kerf, a kerf joint.

Q. As far as holding a transverse member seated in a rectangular kerf, if you so designate it, in a longitudinal member, peening down the adjacent metal so as to create a projection in the process of peening, that was well known in the metal working art before Vandenburgh, was it not?

A. Yes.

Q. I call your attention to the patent to Kieserling, No. 73,004, German, appearing at page 261 of the Pittsburgh record, and to Fig. 5 of the drawing. Does Fig. 5 disclose to you an encircling embracing spiral continuous in one direction seated in kerfs?

(Testimony of Horace R. Thayer.)

A. Yes sir.

Q. The only difference between that kerf and Vandenburgh's kerf is that the projection does not affirmatively and clearly appear to have been battened down or pressed down over the coils? That, and the fact it was not collapsible because of the number of bars?

A. No, the ring on the outside, that is, the enlargement of the bottom, which would prevent the collapsing.

Q. Because as a part of Kieserling he showed an enlargement such as the top of Fig. 8?

A. He does not show any pounding down but I imagine that was pounded down.

Q. That would be the natural thing to do, that would be the assumption. So that the distinction you make in that respect is that it was not collapsible, because spread out at the top as shown in Fig. 8?

A. Yes, and of course this is substantially a different type of construction. It is a pipe construction, the laws of which are different from that of columns.

Q. But as in Hyatt, the British patent heretofore referred to, at page 189 of the Pittsburgh record, you could either have the hollow pipe as shown in Fig. 2 of Hyatt or you could have the solid member as shown in Fig. 5?

A. Yes.

Q. Now, coming back again to Kieserling, his Fig. 7-a, b, c, and referring to the outer right-hand fig-

(Testimony of Horace R. Thayer.)

ure or detail as Fig. 7-c, you find there the rectangular kerfs in the edge of a bar, do you not?

A. Yes sir.

Q. That was for a different method of carrying out the same thing as Fig. 5, just a difference in detail of attachment?

A. Yes sir.

Q. Does that indicate to you or suggest whether or not those edges might be peened down or not?

MR. GRIFFIN: I object to the question. The patent speaks for itself. It requires no interpretation by this witness.

A. Why, I would imagine that that could be done.

MR. GRIFFIN: I move to strike out the answer of the witness, as he indicates by the answer that he has no knowledge upon that subject.

Q. Now, turning to Prescott and Bennett, patent No. 447,162, appearing at page 299 of the Pittsburgh record, and turning to Fig. 3 thereof, that actually discloses the familiar process you have referred to and which you deem probable in the Kieserling patent of peening down the edges of the longitudinals adjacent to the rectangular kerfs for the purpose of enclosing the transverse member, does it not?

A. Yes sir.

Q. That is made plain in the patent itself, commencing at line 47 of the patent, reading as follows: "On the shaft G are secured sets of spokes K which support at their outer ends longitudinally-extending bars L, each provided with recesses L′ formed on their inner sides and adapted to receive the coils

(Testimony of Horace R. Thayer.)

of a wire N forming the meshes of the screen. The wire N is coiled in cylindrical form and is passed into the several recesses L′ of the longitudinal bars L after which the part L2 extending between two successive recesses L′ is hammered so as to cover the coil, thereby holding the latter in place on the longitudinal bars. The coil of wire N extends throughout the length of the bars L and the coils are placed suitable distances apart." That makes it perfectly clear, does it not?

A. Yes sir.

Q. Calling your attention to the patent to Bauman, No. 212,645, of 1879, that shows the transverse sections in Fig. 1 seated in rectangular kerfs in the longitudinal section.

MR. GRIFFIN: Possibly, to expedite the matter, I can make this admission, which I made yesterday in court, that we admit that prior to this invention it was old to secure sundry transverse members to other members by means of kerfs which were hammered down upon the transverse members, but not in connection with spirals or spiral concrete reinforcing.

MR. GUTHRIE: Does that include also an admission that the transverse members so seated in the kerfs of the longitudinals were held in place by peening down the intervening section of the longitudinal so as to there by the process of peening create a spur or projection from each side over and enclosing the transverse member?

MR. GRIFFIN: Yes, that will include the pro-

(Testimony of Horace R. Thayer.)

duction of a spur or prong on both sides of a slot cut into the bar at right angles thereto.

MR. GUTHRIE: Will you also admit, Mr. Griffin, that that method was common and well known?

MR. GRIFFIN: Prior to the grant of the patent?

MR. GUTHRIE: Yes.,

MR. GRIFFIN: Why, certainly. It is shown in these patents. There is no need of examining the witness upon those patents.

Q. Now, I will call your attention to the patent to Kahn, No. 736,602, appearing at page 304 of the Pittsburgh record. Kahn's figures as a whole show, do they not, the principle of a reinforcing bar or beam construction, consisting of a principal longitudinal member with attached diagonals extending in opposite directions from the center of the bar?

A. Yes sir, in the main. Most of the figures show that.

Q. Showing also a number of available methods of attaching the diagonals?

A. Yes sir.

MR. GRIFFIN: I object to the questions upon this patent, as the patent shows upon its face that it in no way discloses any spirals or means for attaching spirals to any longitudinals, and it is irrelevant and immaterial.

Q. Showing also a variety of means of creating the subsidiary diagonals to function in connection with and assist the main longitudinal, such as the

(Testimony of Horace R. Thayer.)

diagonals punched out of the center of the longitudinal?

A. Yes sir.

Q. Or punched out of the side of the longitudinal, or riveted to the longitudinal, or extending with a hub or bolt at the lower side through holes in the longitudinal.

A. Yes sir.

Q. In the description of the Kahn patent, do you find a disclosure to you, as an engineer, that these subsidiary diagonals would assist in creating and effectuating the function of the tension bar by right angling substantially the oblique crack tendency of concrete, getting a grip up in the concrete transferred to the main bar and developing the truss action?

A. Yes sir, substantially as has been already mentioned.

Q. Now, in these aspects of beam construction the Vandenburgh patent departed from the Kahn patent in only two items of detail, that is, the better encircling by the subsidiary members through the use of a hoop, and the commercial advantage of seating the loop diagonals in these kerfs.

MR. GRIFFIN: I object to the question as irrelevant and immaterial. The patents show for themselves wherein the differences are.

A. The Kahn method would be better for beams, the Vandenburgh method better for columns. I think, unless I am mistaken, that Kahn tried to use this scheme for columns—

(Testimony of Horace R. Thayer.)

Q. If you will kindly give attention to my questions and answer them directly, we will progress to matters which you sometimes seek to anticipate.

The question was whether there was any departure in Vandenburgh over Kahn except the substitution of encircling subsidiary members, which obtain a better hold upon the concrete, and the commercial advantage of fixing a continuous coil in kerfs to create the diagonal members? I am speaking now exclusively from the standpoint of beam construction.

A. I will have to answer about the same as I did before, namely, that the Vandenburgh method was better, proved to be better, in column construction, but not as good in beam.

Q. I did not ask you which is better. What I asked you was not which was better, but whether Vandenburgh departed from Kahn in any way except in the two respects I have mentioned, as far as beam construction was concerned.

A. You spoke about that as being advantageous. I agree with you—

Q. I did not ask you anything about advantages. I asked whether Vandenburgh departed from Kahn from the standpoint of beam construction except in substituting the detail of an encircling loop for Kahn's straight subsidiary diagonal, and attaching loops through kerfs instead of attaching the straight bar as Kahn did? Was there any other departure or change on the part of Vandenburgh as far as beams were concerned?

(Testimony of Horace R. Thayer.)

A. I think, in general, that statement well represents the difference.

Q. Now, I call your attention to lines 12 and following on page 2 of the Kahn description, as follows: "In Figs. 6, 7, 8 and 9 is shown a construction which may be used as a column in which the metallic strengthening members are arranged adjacent to each of the sides of the body." Do these figures, particularly Fig. 7, show a design for columnar construction by the adaptation of Kahn's bar with diagonals all extending in one direction by the placing in the column of two opposing bars with diagonals in such manner that the bars crossed each other towards the center of the column?

A. Yes sir.

Q. Now, except for the substitution of a loop for a bar and the affixation through the kerfs, as shown in Vandenburgh, is not this the same functional idea in columns as is shown or attempted to be shown in what you term the impracticable suggestion of Vandenburgh in his Fig. 6?

A. Yes sir.

Q. Following Kahn, I call your attention to the Pohlman patent No. 766,899, found on page 311 of the Pittsburgh record. That discloses the idea of a reinforcing bar with subsidiary diagonals in which the diagonals are constituted of independent loops at an angle of about forty five degrees, and oppositely extending from the center of the column, does it not?

A. Yes sir.

Q. That differs from Vandenburgh, however, in

(Testimony of Horace R. Thayer.)

that the loops are each independent instead of part of a continuous coil?

A. Yes sir.

Q. And in being secured through holes in the main bar?

A. Yes sir.

Q. And Peabody patent, No. 805,663, page 317, discloses the same idea?

A. Yes sir.

Q. Except that the loops are double and attached to the main bar in a different way?

MR. GRIFFIN: Objection is made to the questioning upon the Peabody patent, for it shows upon its face that it contains nothing relating to spirals or means for securing spirals to a longitudinal fastening.

Q. Is the same true of the Golding patent, No. 815,157, at page 320 of the Pittsburgh record?

A. Yes sir.

Q. And of the modification in use of the Golding idea shown in Fig. 2 of the cuts on page 392 of the Pittsburgh record?

MR. GRIFFIN: Objection is made to any questioning or use of the exhibit on page 392 of the Pittsburgh record upon the ground that the exhibit is in a publication dated March 15, 1906, which is less than two years prior to the filing date of the original patent.

A. Yes, practically the same idea.

Q. The advancement of Golding as shown in this construction, said to be used by The Monolith Steel

(Testimony of Horace R. Thayer.)

Company, is that he uses a method of attachment which does not change the sectional area of the bar at any place?

A. Yes; as I recollect it, he jams down the sides of the reinforcing bar.

Q. On the continuous slots?

A. Yes sir.

Q. Vandenburgh, Kahn, Pohlmann and Peabody all had this objection to their bars, that their method of reinforcement change the sectional area of the longitudinal bar so that it made it weaker in places than in others.

MR. GRIFFIN: Objection is made to questioning upon any of these patents for the reason that none of them show any spiral reinforcing, and that it is incompetent and immaterial.

A. No, I could not answer that question affirmatively. I know Kahn worked out his process. I put in Kahn bars and I followed that through. Kahn works out his system of reinforcement so that as far as possible the sectional area is maintained at the point of maximum moment.

Q. That is, he does not reduce it at the center where the strain is the heaviest?

A. He does not reduce it at the center where the strain is heaviest, so that I could not agree with you on that. That is, a good many of his bars he arranges it so that it can be done. In some bars he does not. I could not agree with you entirely on this question.

Q. Kahn and his company have been the biggest

(Testimony of Horace R. Thayer.)

people in this business since they started, haven't they?

A. Well, they have been pretty big people.

Q. Without agreeing as to whether it was a real advancement, Golding's idea was that he was advancing it by having a continuous section of the same area?

A. Yes sir.

Q. Do you find in the Vandenburgh patent any reference to or suggestion of the use of his device in column construction other than in paragraph commencing at line 89 of page 1?

A. Yes. Line 20, he says—beginning with line 16,—"The invention has for an object to provide a reinforcing bar with one or more spirally-disposed coils secured to the bar so as to provide an extended area of contact adapted to resist strain longitudinally and laterally of the bar," etc.

Q. Do you think that suggests a column?

A. I would think so.

Q. Do you not think it suggests this strain of fracture laterally of the beam across the line of obliquity of the subsidiary member?

A. No. He says, "to resist strain longitudinally and laterally." I would infer "longitudinally" meant for columns and "laterally" for beams.

Q. Other than that construction, do you find any other reference to columns except as I have indicated, commencing line 89, page 1?

A. Yes, line 39 speaks of column construction.

Q. I am talking about any suggestion not of col-

(Testimony of Horace R. Thayer.)

umns but of how his device might be used in constructing a column. Do you find anything else in the patent than what commences at line 89 of page 1 suggesting the manner in which his device might be used in a column?

A. Well, he devotes about one-third of the specific matter of his description to columns.

Q. Where? Quote it?

A. I would call lines 1 to 29 general, lines 30 to 88 beams, and lines 89 to over on to the second page columns or beams in general.

Q. Now, omitting the general, and sticking to the specific as to claims, does Vandenburgh anywhere describe a method for the use of his reinforcing bar in columns except in the paragraph commencing with line 89, page 1?

A. I think that second paragraph, that is, the one beginning with line 97, was a continuation of the work begun in the preceding paragraph, referring to that Fig. 6.

Q. Beginning again now, if we must diverge, and I must use some loops with you as well as Vandenburgh, does with this construction, I will ask you if the paragraph commencing with line 97 that you have just referred to, does not call for coils extending in opposite directions and forming a truss?

A. That might be.

Q. That would not be column construction of a continuous spiral, would it?

A. Oh yes. I do not see that prevents the assumption I made in regard to it. In fact, if you will read

(Testimony of Horace R. Thayer.)

the first paragraph of page 2, I think it will be quite apparent that the intermediate paragraph is taken up largely with column work. He says in the latter part of that paragraph: "This bar, although described in connection with arcs and column construction, is adapted for use in any character of metal, reinforced concrete or cement construction." It is evident all the time he has been talking of column work.

Q. You think his first and primary idea is of columns, do you?

A. No. I said I think about one-third of his idea was columns, and two-thirds beams.

Q. You want the court who tries this case and hears your testimony to believe that you, as an expert, believes that a spiral coiled helicoidally, continuously, from one end of the spacing bar to the other, is the same thing as coils extending in opposite directions, do you?

A. I take it that these coils extending in opposite directions refer to Fig. 6 there.

Q. Going back again to line 89 and the following lines, and just assuming, without any of your theories about it, but assuming it as a fact for the purpose only of your answer to this question, that that is the only method which Vandenburgh discloses for the use of his bars in a column, would that particular method of use be the same theory of use as disclosed by Kahn in his Fig. 7, page 304?

A. Yes sir.

(Testimony of Horace R. Thayer.)

The two men had exactly the same idea, I would say.

Q. Well, as an engineering term, intended to clearly describe to another who did not know what idea you had in mind, and must get his idea of what you did have in mind from the language or term used, would you say that a coil with its convolutions seated in recesses in a spacing bar of such light construction that the spacing member would not be taken into consideration in calculating the strength resulting in the finished structure was properly called a bar?

A. The term "bar" is not ordinarily used in referring to what they call spirals, still they use them at the present time up to one half inch in diameter and they call that a bar.

Q. Where the longitudinal is of a size and design to furnish in itself, whether aided or unaided, the primary substantial reinforcing strength, you call it a bar?

A. I would think so.

That line is not clearly established.

Q. To put it in another way, where the straight bar was the main thing, you would call it a reinforcing bar even though it might have some incidental attachments?

A. We would call it a reinforcing bar where you figure it in the stresses. Where it is not figured, we call it a spacing bar, provided it is used to hold the spirals in position.

Q. And where a coil was the main thing and was

(Testimony of Horace R. Thayer.)

the part upon which you depended functionally, you would call it a coil, would you not?

A. Yes. "Hooping" is the term I have ordinarily used.

Q. Hooping is a term that has been well known since Considere?

A. Yes.

Q. Now, in answer to a question by Mr. Griffin, I understood you to state that these patents subsequent to Vandenburgh, McClure, No. 992,970, Burk, No. 1,016,319, Bindley and Mogan, No. 1,115,490, Turner, No. 1,159,297, and Hough, No. 1,172,026, disclosed constructions substantially the same as Vandenburgh?

A. Well, they had Vandenburgh's idea of connecting them up, spirals, by means of integral connections to spacing bars.

Q. Assuming that column hooping was within the disclosure of the Vandenburgh patent, this McClure patent showed everything in Vandenburgh and in Defendant's construction, Defendant's Exhibit No. 1, including a coil and two spacing bars and the identical form of kerf pressed down and tongue of Vandenburgh, so that if it was not pressed down too tight, it would be collapsible, did it not?

A. That would ordinarily be collapsible.

Q. And to the rest of my question you would answer in the affirmative, would you?

A. Would you repeat it?

(Question read)

A. Yes. It shows the Vandenburgh method of

(Testimony of Horace R. Thayer.)

connecting to the spacing bar but the spiral is continuous between the two bars rather than made in two separate spirals.

Q. What do you mean by made in two separate spirals?

A. Two separate spirals as shown in this Fig. 6, whereas in this one is shown as one spiral around the two spacing bars. The McClure patent differs from the Vandenburgh patent in Fig. 6 in the fact that there is only one spiral in the McClure patent. It differs from Fig. 4 in the Vandenburgh patent in the fact that there are two spacing bars in the McClure patent while there is only one in the Vandenburgh.

Q. But what do you say as to the statement that you have already made as to these three details in the Vandenburgh drawings, Figs. 3, 4 and 6, that they are only details showing the arrangement of part of his bar and do not cover a showing of his bar as a whole?

MR. GRIFFIN: Objection is made to the question for the reason that no figure other than Fig. 4 of the Vandenburgh patent is in issue herein.

A. The statement he made at that time was that this shows the method, that the exact sizes, etc., should be matters of computation and design.

Q. Taking now claim 1 of the McClure patent, reading as follows: "1. A reinforcement for reinforced concrete columns, comprising an encircling reinforcement element having a plurality of spaced encircling members, and spacing bars for said encirc-

(Testimony of Horace R. Thayer.)

ling reinforcement element having notches in which the reinforcement members of the reinforcement element are rotatively secured and having over-hanging portions for loosely holding said encircling members in notches, whereby said spacing members may be shifted longitudinally of themselves to bring said encircling reinforcement into collapsed form," and assuming for the purpose of your answer to this question that there is no contest but that Vandenburgh disclosed a spiral continuous in one direction and disclosed the suggestion of two spacing bars instead of one, and disclosed a kerf in connection with an operhanging spur not rigidly bent down so as to prevent the collapse of his spiral,—assuming all of that, does not that description or those terms in the McClure claim cover identically what Vandenburgh had previously patented?

MR. GRIFFIN: I object to the question as incompetent and immaterial, and a proper subject matter for the interpretation of the court, and upon the further ground that whatever the subsequent patents may cover is immaterial to any issue in this case, the McClure patent having been filed after the Vandenburgh original patent was filed.

A. I would think it was very similar to the Vandenburgh patent, very, very similar.

Q. Now, if the McClure patent was issued in the same division of the Patent Office, recommended by the same principal examiner, W. A. Cowles, as had recommended the Vandenburgh patent, wouldn't you say that the Vandenburgh patent would have been

(Testimony of Horace R. Thayer.)

a proper reference against the allowance of that claim to McClure?

MR. GRIFFIN: I object to the question upon the ground that this is purely speculation upon the part of the witness and that it is no province of his to determine what should or should not be cited by the examiner in the prosecution of any case, hypothetical or otherwise.

A. I would think it would have, yes sir.

Q. And the same would be true of these other patents that I gave you a list of recently, which you said were similar to Vandenburgh?

A. I would think so, yes sir.

Q. Then, in order that I may clearly understand you, if you had been the examiner who passed these McClure and subsequent column hooping patents to issue, and also had been the examiner who had passed the Vandenburgh patent to issue, you would have declined to pass the subsequent patents to issue unless you was of the opinion that Vandenburgh had not intended to patent or to cover column hooping?

MR. GRIFFIN: The same objection, and the further objection that this witness has not been qualified as competent to testify as to the actions to be taken by an examiner in the prosecution or allowance of a patent case.

A. Shall I answer?

MR. GRIFFIN: Q. Yes, I am getting tired of this. I do not think we will answer that question. If you want to continue this examination for four or five days, we will go to the court about it.

(Testimony of Horace R. Thayer.)

MR. GUTHRIE: If it had not been for your objection, I would have been through by this time and will be in a few minutes. I will be through sooner the more directly the witness answers the questions.

MR. GRIFFIN: He has no right to answer this question at all. It is not a proper question to put to him. I will let him answer it.

A. I would not have passed the subsequent patents if I had thought Vandenburgh had intended to cover column hooping.

Q. I will call your attention now to a certified copy of the file wrapper and contents of this McClure patent. And ask you to note the references, the amendments and the arguments of counsel for patentee, and see whether you discover in there anything to indicate that anybody during the prosecution of the McClure patent, had any idea that the Vandenburgh patent had anything to do with column hooping?

MR. GRIFFIN: I object to the question upon the ground that the prosecution of any case subsequent to the case of the Vandenburgh original patent could not bind Vandenburgh in any way, and as incompetent, irrelevant and immaterial.

A. I do not see anything in regard to the Vandenburgh patent.

Q. I will ask you the same question with reference to the certified copy of the file wrapper and contents of the subsequent Wedmore patent, No. 918, 715, 1908, referred to on page 384 of the Pittsburgh record?

(Testimony of Horace R. Thayer.)

MR. GRIFFIN: The question and answer is objected to on the ground that the Wedmore patent was filed more than two years subsequent to the filing of the original Vandenburgh patent, and that any action taken by the Patent Office thereon cannot bind this plaintiff.

A. I do not find herein any reference to the Vandenburgh patent.

Q. I now call your attention to the certified copy of the file wrapper and contents pertaining to the original Vandenburgh patent, and the re-issued patent in suit, commencing on page 330 of the Pittsburgh record, and the Much (Munch) and Mueser patents, referred to on page 340 of the record, and to the Peabody patent referred to on the same page, and the reference of examiner Cowles, page 343 to the Kahn patent, which are found in the Pittsburgh record on page 368, 377, 317 and 304, respectively. Will you kindly examine those four patents carefully?

A. Yes sir.

Q. Do you find in the Munch patent a construction primarily of beams and girders or of column hooping?

MR. GRIFFIN: The question is objected to as it is immaterial at the present time what the citations made by the Patent Office were during the prosecution of the applicant's case.

A. It seems to me it is a beam.

Q. It says in the description: "A reinforcing for load",—

(Testimony of Horace R. Thayer.)

A. It is headed "A new idea for beams". Evidently intended for beams only.

Q. Is Mueser, page 377 of the Pittsburgh record, also confined exclusively to beams?

MR. GRIFFIN: The same objection.

A. Well, I would have to suggest there it looks to me like a mistake. The other references seem pat This one does not. I do not see the parallelism at all.

Q. The question I am asking is whether the Peabody patent pertains to anything but beams or has any reference to columns?

A. You mean the Mueser patent?

Q. The Peabody is the one I have got down here now.

MR. GRIFFIN: Mueser is the one you are talking about.

THE WITNESS: I do not see any parallelism at all.

Q. Mueser has got nothing to do with columns anyway, has it?

A. It is "material of construction." It might be either columns or—it is a deformed bar. That is what it is. I do not see the relation between a deformed bar and spirals.

Q. Perhaps the examiner thought, if I may suggest to you, that the projecting rings of this deformity might have a little effect as diagonals. Peabody, on page 317, has no reference to columns, has it?

MR. GRIFFIN: The same objection.

A. That looks like beam construction on the out-

(Testimony of Horace R. Thayer.)

side. But it is headed "Materials of construction." It is called "Materials of construction", and the entire claim is general, but I would think from the appearance of the construction it was largely intended for beams.

Q. It could be by no stretch, from an engineering standpoint, apply to the idea of circular reinforcement to prevent expansion in columns?

A. I do not see it. No.

Q. The same thing would be true of Kahn's patent?

A. It would have to be used, if used for columns, in the same way that Kahn did.

Q. I now call your attention to these references. Will you examine these two file wrappers of Vandenburgh carefully and see whether you find any suggestion that the Vandenburgh patent was supposed to apply to any such construction as helicoidal embracement of concrete in a column to prevent expansion?

MR. GRIFFIN: Objected to, as the file wrappars are in the English language and speak for themselves.

A. Why, yes. On page 333, "The invention has for an object to provide"—

Q. Pardon me, but that is from the description which we have already discussed. I mean in the proceedings of the Patent Office.

MR. GRIFFIN: I object to that question upon the ground that it is irrelevant, immaterial and incompetent, and that no action of the examiner can

(Testimony of Horace R. Thayer.)

bind the present plaintiff other than the official action taken as appears in the file wrapper. And the further objection that whether the structure was to be used for columns or not might or might not appear from the file wrapper without in any way defeating the plaintiff's rights.

A. I do not find anything specifically referring to columns of a further nature than what we have already discussed.

Q. Now, I desire to call your attention to the argument made to the Patent Office by Vandenburgh's counsel in answer to the reference to the Swiss patent to Munch, appearing on page 345 of the Pittsburgh record, and call your attention specifically to the statement on behalf of Vandenburgh as a basis for the procurement of the allowance of his claims, "that the Swiss patent does not show the wire deflected towards the opposite ends of the bar," and further, "that by applicant's structure", stars,—

MR. GRIFFIN: I object to inserting any quotation unless the entire matter is taken. And I further object to quoting into the record matters already of record.

Q. Go ahead after the stars,—"the spiral strands when imbedded in the concrete form a structure extending continuously from the center toward the opposite ends of the bar." I desire to ask you whether in your judgment as an expert and an engineer those statements amounted to an assertion that the only device under which Vandenburgh was

(Testimony of Horace R. Thayer.)

contending as to invention was a device where the subsidiary deflected wires extended from the center toward opposite ends of the main bar, and not to a construction where the wires were coiled continuously in one direction from one end of the bar to the other?

MR. GRIFFIN: Objection to the question as it is a matter purely for the interpretation of the court, and I refuse to let the witness answer. We will go to court on that, if you want to continue this examination this way,—

MR. GUTHRIE: I happen to be right at the end of this.

Q. Professor, when did you actually first design a column hooping construction for a column?

A. Now, I could not answer that question. My recollection is that I have designed them but coming up on the train I was trying to place when I had, but I cannot place it just now.

Q. Refreshing your recollection by your testimony on the previous trial, was it not in the year 1917?

A. It might have been. I don't remember that I stated the exact date in the previous trial but I might have. My recollection was that I said I had designed them and that is still my recollection, but I cannot place the exact time or the exact place it was done.

Q. It was about that time, anyway, was it not?

A. I suppose so.

(Testimony of Horace R. Thayer.)

Q. You spoke of yourself as a teacher in the Carnegie Institute.

A. Yes sir.

Q. What position do you hold?

A. I am an associate professor of structural design at the present time.

Q. How long have you held that position?

A. I think I was made associate professor a couple of years ago. Before that I was assistant professor.

Q. Who is the head of that department?

A. A man by the name of McCullough.

Q. How many subordinates are there of equal rank with yours?

A. One.

Q. Beside yourself?

A. Yes.

Q. Have you been a writer also? to any substantial extent?

A. Yes sir.

Q. What?

A. I have written two books on structural design. I have another book on skew structural design that is ready for the printer but is held up by industrial conditions. I have a book on masonry partly finished and I have written quite a number of technical articles.

Q. At the other trial you mentioned a couple of technical articles. What were they and what others were there?

A. I wrote an article on the history of masonry

(Testimony of Horace R. Thayer.)

failures I wrote an article on the subject of masonry arches, and delivered it before the Engineers' Club of Baltimore. I wrote an article on the historic failure of steel structures for the Engineers' Society. I have written a number of magazine articles.

Q. Specify them?

A. I wrote an article for the "Engineering and Contracting Magazine" on the method for obtaining the temperature stresses in a continuous arch. I wrote three articles for the "Real Estate Journal" on semi-technical subjects and I have read a paper or two before the American Association of Engineers; that was in manuscript form.

Q. On what subject?

A. General subjects in the engineering profession.

Q. These articles on masonry, what type of masonry do they cover?

A. It was intended to cover all masonry structures.

Q. Brick and stone and reinforced concrete?

A. Yes.

Q. How large a book was this that covered this wide subject?

A. You take it those articles would cover perhaps—

Q. I am asking you about the one on history of masonry failures.

A. That was a paper read before the Engineers Society. It would be equivalent to about thirty pages of one of these records perhaps.

(Testimony of Horace R. Thayer.)

Q. What was the book you have actually published as a book?

A. I have two books published, "The Elements of structural Design." That book is now in its second edition. And "The Design of simple structures," the first edition of which is nearly exhausted and we have got to replace it very shortly now or give it up.

Q. What did "Simple Structures" cover?

A. That covered steel structures, bridges, and buildings, timber and steel.

Q. What did this other book cover?

A. Which book was that?

Q. The one that is in the second edition now.

A. Those both took up steel and wooden structures.

Q. Then you have never written any articles or published any books especially upon the subject or reinforced concrete, have you?

A. Yes, I have a book partly ready on that subject, and these articles I spoke of, the article in "Engineering and Contracting," the "Failure of Masonry Structures" was partly on reinforced concrete.

RE DIRECT EXAMINATION BY MR. GRIFFIN:

Q. Is there any advantage in the final column having the individual coils securely fastened to the longitudinals?

A. Yes sir.

Q. Will you state what that advantage is?

(Testimony of Horace R. Thayer.)

A. The advantage that it provides against displacement either laterally or vertically, both of which are very serious and interfere largely with the strength of the column; that is, to allow the one coil to be so far displaced as to be up against the next coil would weaken it just as much as if that were the uniform spacing.

Q. Will you take the Pittsburgh record and examine the Mollins patent, page 271?

A. Yes.

Q. Look at the drawings. How are the spirals secured to the longitudinals in that case?

A. By clips.

Q. Would it be feasible to clip all of the spirals in a large building to the longitudinals?

A. It would be very expensive, so expensive as to be impracticable.

Q. Do you regard clip fastenings as good as the integral prong fastener?

A. No sir; they are likely to be displaced.

Q. With respect to the beginning of the reinforcing, what have you to say as to the inherent character or collapsibility of the spiral where the single bar is used at the beginning of the work?

A. Please repeat that.

(Question read)

A. The single bar as ordinarily used with the spiral is collapsible unless the fastening is made of such a character as to bind.

Q. Or to actually prevent the collapsing?

A. Yes sir.

(Testimony of Horace R. Thayer.)

Q. Would riveting each individual coil be feasible?

A. It would be very expensive.

Q. What would be the effect of cutting rivet holes in the reinforcing?

A. It would lessen the strength of the spiral to that extent. It would practically mean that the spiral would have to be considered as the area with the rivet hole deducted.

Q. The Hyatt patent that you were so extensively examined upon in the Electric Welding record is also shown in the Concrete Steel record is it not?

A. Yes, it is shown in both.

Q. And the Prescott and Bennett patent is also shown in the Concrete Steel Record, is it not?

A. Yes sir.

Q. Has the flat spiral band reinforcing of the Hyatt patent anything in common with present-day coil reinforcing?

A. No, only the form.

Q. Will spacing bars arranged flat to the periphery of the spirals and without a radial extending member make suitable spacers for spiral reinforcing?

A. No.

Q. Why?

A. Because the most economical form of a bar in a column is the square bar, that is, for a given area. If you have a given area to put in, we ought to make it square because that is the form of the greatest strength, or approximately square.

(Testimony of Horace R. Thayer.)

Q. Do you know about the prosecution of patent cases in the Patent Office so as to be able to say what the Patent Office should do or should not do in a given case?

A. No, I do not know very much about it.

Q. Do you regard Vandenburgh's construction as an advance over the art or not?

A. An advance over the art at the time it was gotten out.

Q. Referring now to the Golding patent, page 320, would you say that the means for securing the loops to the longitudinal bar in that case were capable of developing the full strength of the loops or not? What have you to say with regard to that connection?

A. That would depend altogether upon the force that was used in jamming it down. I would think that it might if it was suitably jammed down. One great disadvantage of this type of construction is that it might be a variable quantity. Might be hard to estimate just what the force used was.

Q. As a matter of fact, practically the entire connection between the longitudinal bars and the loops is the frictional engagement due to pressing down of the material on those ends, is it not?

A. Yes sir.

Q. That would not be likely to develop the full strength of the bar?

A. It would be perhaps a question of some doubt.

Q. It would depend something on the material.

(Testimony of Horace R. Thayer.)

Hard steel would be far less likely to produce it than soft steel.

Q. Do you remember the model that was filed in the Electric Welding case as showing the Electric Welding Company's alleged infringing construction.

A. I think I have seen it. I do not remember it clearly, as to just what it was.

Q. What was the character of that model, do you remember?

A. I could not say clearly what it was.

Q. Will you now examine the Kieserling patent page 261?

A. Yes sir.

Q. Is there or is there not anything shown there to indicate the securing the spirals to the longitudinals?

A. Yes, there is a hole through the bar or a kerf through the bar.

Q. And as far as that patent goes there is nothing said about actually securing the spirals to the longitudinals? You said something about imagining that the spiral was fastened. That is pure guesswork upon your part?

A. That was pure guesswork, yes.

MR. GUTHRIE: Was it your judgment of what a man who had some sense would do?

THE WITNESS: That is my idea of the way it ought to be handled, the way I would do it.

Q. That was based purely upon your idea as to what ought to be done in that case?

A. Of what ought to be done.

(Testimony of Horace R. Thayer.)

Q. And not upon what had been done. Looking now to Vandenburgh's reissued patent, suppose the coils of Fig. 6 were about eighteen inches in diameter and six or eight inches in pitch, and were assembled as shown in Fig. 6, would you say that would be a practicable or an impracticable construction?

A. Well, it would carry a load. It would not be as good as the type of column that we put up at the present time.

Q. I will ask you to look at Plaintiff's Exhibit No. 4 and direct your attention to the table on page 27, and ask you to examine the dimensions of the core of the column given at the top of the page, and ask if two small vertical bars were spaced inside the spirals and if they had three-sixteenths of a square inch of defective section, whether or not they would lend any substantial reinforcing in addition to the spirals in such a column as that?

A. It would be very small. Most engineers would ignore it.

Q. What would be the total breaking strain of two such bars in such a column?

A. We would figure, I think, at seventy five hundred pounds per square inch, and then of course they would take away an equal area of the core. That would be equivalent to making them seven thousand pounds to the square inch. That would be roughly three hundred pounds apiece that they would add.

Q. That would be the breaking strain?

A. That would be the safe load. I beg your pardon. What I have given would be the safe load.

(Testimony of Horace R. Thayer.)

Q. The breaking strain?

A. The breaking strain would be about four times as large. Excuse me. I should have said the breaking strain would be about two and one-half times as large instead of four times. That is in compression, you see.

Q. What is the chief advantage of spirals over single bands?

A. They do not have to be joined together at every turn which is a very expensive process and likely to result in weakening the bands.

Q. If you had a whole series of bands, a large number such as are in a building, built with a large number of spirals, would it be likely that all of the joints would be equally good?

A. It would be hard to make them equally good.

Q. Have you ever seen different size spacing bars used on Truscon spirals?

A. I have seen different size longitudinal bars in recent mixups due to freight congestion, I suppose.

Q. What are the sizes.

A. I don't know. They would simply have a lot of different bars. I assume they had taken some patched up orders to fill out. It is not usual to do that, though.

Q. Could or could not any of the Vandenburgh forms of reinforcing be used in part with good effect in columns?

A. Yes sir.

Q. Is it not common to figure columns in nearly

(Testimony of Horace R. Thayer.)

all instances for some eccentric or beam loading?

A. It is quite common, yes sir.

Q. Even though the design of the columns and beams is different, do you regard it possible without any more than the exercise of mere mechanical skill of the art to produce either beams or columns from the Vandenburgh construction?

A. Yes, because he has taken up the construction for both of those forms.

RE CROSS EXAMINATION BY MR. GUTHRIE:

Q. Would you regard Defendant's Exhibit 1 as showing the column hooping construction which would be, and is it in fact from your knowledge of the Truscon construction, collapsible?

A. Yes sir, that is collapsible.

Q. You spoke of the variability of the human element of manual labor in beating down the steel to engage in a hole of the oblique subsidiary loops of Golding. That same thing would be true of the pounding down of the tongues of the Vandenburgh patent also, would it not?

A. Well, but take it in the first place that can be inspected, that is, it is usual to inspect the steel after it is in position, and if it was not done the inspector would know it and know it before pouring was started, whereas in the other case he has no means of getting at it, he does not know whether it is done or not.

(Testimony of Horace R. Thayer.)

Q. That will not cover the matter of its jumping out of the place and loosing its engagement?

A. He can see if the pounding down is not properly done. Furthermore, unless the work is badly slighted, in the system at present used in spirals, the spirals would not be likely to come out, that is, if it was omitted in one or two places the spirals would not be displaced because the others hold it very well.

Q. This matter of the collapsibility of a structure of that kind is partly dependent upon the ratio of the pitch, that is, the distance between the spirals as compared to the diameter of the spirals, is it not?

A. That is one thing. There are quite a number of elements entering into it.

Q. Taking them one at a time, another would be the size of the spirals, would it not?

A. Yes sir.

Q. Another would be the tightness or looseness of the engagement at the kerf?

A. Yes sir.

Q. Now, taking a spiral where the diameter of the spiral is only about twice the distance between the spirals, and assuming that the wire is of such texture that it could not be bent down by force, which would distort it, and then spring back, but that if it was bent down by force which would produce distortion, it would remain, would you consider that a column hooping having a spacing of substantially one half the diameter of the coil itself would be collapsible without distortion?

A. The collapsibility depends on so many things

(Testimony of Horace R. Thayer.)

that an answer to that question would be very difficult. For instance, a spiral that theoretically would not be collapsible would be readily collapsed by distorting the structure sometimes.

Q. I am asking you to eliminate distortion and to assume that the spirals are spaced about one half the diameter of the spiral. I am asking you whether such a continuous spiral, continuous in one direction, I mean, could be collapsed and restored without distortion in the process, at that spacing?

A. Well, I take it my impression would be that unless you assume some distortion you could not get collapsibility in any case. It involves some little distortion, but in an ordinary spiral the distortion of it is so small that it is negligible and very easily accomplished.

Q. That is because of the close spacing?

A. Yes sir.

Q. But take the spacing of one-half in length longitudinally to the diameter of the coil, you could not with the materials that we ordinarily have collapse that coil and restore it without a distortion that would be more than negligible, could you?

A. Well, I would imagine you could. If you have ever been on actual work, you know that some of the stuff that comes from the mill comes in very, very poor shape and some of it is badly bent and battered out of shape, but unless it is broken or something of the kind, they always hammer it back and put it in again.

Q. I will put it in another way. If the spacing

(Testimony of Horace R. Thayer.)

longitudinally was one half of the diameter of the coil, you could not collapse it without seriously distorting the material and the distortion would have to be remedied before it would be in good shape for use, would it not?

A. I would think so, for ordinary commercial sizes.

MR. GUTHRIE: Defendant offers in evidence as part of the deposition, as Defendant's Exhibit 7, those of the subsequent patents identified by the witness Thayer as being substantially the same construction as that he says is in Vandenburgh, not already introduced in evidence, those introduced being Burk, No. 1,016,319, Bindlay and Mogan, No. 1,115,490, Turner, No. 1,159,297, and Hough, No. 1,172,026. Also certified copies of the file wrapper and contents of the McClure and Wedmore patents offered in evidence yesterday, but not appearing to be identified as exhibits, and they are now offered as defendant's Exhibit 8.

The file wrappers of patents subsequent to the patent in suit, including references made by the patent Office as against claims presented, nowhere contain any reference to the patent in suit as a reference affecting the claims allowed in such subsequent patents.

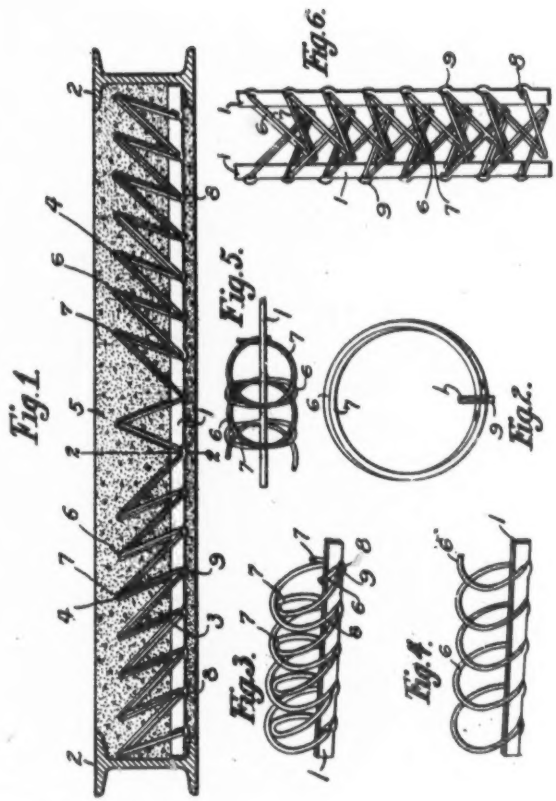
208

G. E. VANDENBURGH.

REINFORCING BAR.

APPLICATION FILED JULY 1, 1916.

Reissued Aug. 15, 1916. 14,182.



INVENTOR.
George E. Vandenburgh.

BY
Carlos P. Griffin
ATTORNEY.

UNITED STATES PATENT OFFICE.

GEORGE E. VANDENBURGH, OF SAN FRANCISCO, CALIFORNIA.

REINFORCING-BAR.

14,182. Specification of Reissued Letters Patent. Reissued Aug. 13, 1916.

Original No. 841,741, dated January 22, 1907, Serial No. 315,889. Application for reissue filed July 1, 1916. Serial No. 107,208.

To all whom it may concern:

Be it known that I, GEORGE E. VANDENBURGH, a citizen of the United States, and recently of Washington, District of Columbia, and now residing at San Francisco, California, have invented certain new and useful Improvements in Reinforcing-Bars, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to a reinforcing-bar particularly adapted for cement and concrete construction wherein the bar is embedded in the plastic body to be supported thereby.

The invention has for an object to provide a reinforcing-bar with one or more spirally-disposed coils secured to the bar so as to provide an extended area of contact adapted to resist strain longitudinally and laterally of the bar and to form a truss within the body of concrete or other plastic material which provides the maximum of supporting strength in the arch or surface to be formed.

Other and further objects and advantages of the invention will be hereinafter set forth, and the novel features thereof defined by the appended claims.

In the drawings, Figure 1 is a vertical section showing the bar applied to supporting girders or beams. Fig. 2 is an enlarged vertical section on the line 2—2, Fig. 1. Fig. 3 is a detail perspective of the primary and secondary coils shown in Fig. 1. Fig. 4 is a similar view of a modified form using one coil. Fig. 5 is a detail plan of the form shown in Fig 3, and Fig. 6 is an elevation of two meshing coils used for girder and column construction.

Like numerals of reference indicate like parts in the several figures of the drawings.

The numeral 1 designates a bar which may be of any desired construction or configuration and supported in any preferred manner. For instance, when used in arch construction it is adapted to rest upon the base of the beams or girders 2 sufficiently above the lower surface thereof to provide for the facing of the concrete or cement with the lower face of the bar. The coils are applied to the bar in any desired manner so as to surround the coils and bar and embed the same therein to form a truss construction.

The bar may be provided with a primary coil 6, extending in one direction, as shown in Fig. 4, which is sufficient in light construction; but when a heavier construction is to be used a secondary coil 7 is provided, which extends in the opposite direction to the coil 6 and through the same so as to cross beneath the coil 6 at a point directly above the bar, thus providing a construction in which all lateral pull or strain of the coil is avoided, owing to the equalization thereof by the oppositely-extending coils and the tendency of the coils to move or flatten toward the face of the bar resisted. This preferred construction is shown in Figs. 1 and 3, and it is also desirable that both of the coils be deflected away from the center of the bar, as shown in Fig. 1, as the greatest supporting strain carried by the arch is at the center thereof, and this deflection therefore resists such strain and tends to draw the coils upward into a position at right angles to the bar.

As a preferred means of securing the coils to the bar I have shown a series of kerfs 8 in one face of the bar inclined away from the center of the bar toward the opposite ends thereof, and the coils are seated within these kerfs and held therein by means of the integral spurs 9, which are forced downward upon the coils when inserted and permanently retain them in position.

In Fig. 6 a modified application of the invention is shown where two of the bars are disposed parallel to each other, with their coils intermeshing, for use in column or girder construction, wherein such a construction provides the maximum of strength with the minimum of weight in the reinforcing material.

In the operation of the invention it will be seen that the bar supporting the coil resists any movement thereof longitudinally of the bar and provides the necessary strength upon which the truss structure formed by the coils is carried. These coils being extended in opposite directions and embedded in the material provide the maxi-

weight and quantity of material, as owing to their opposite direction of curvature they effectually oppose the strain placed thereon, while their deflection toward the opposite ends of the bar resists the central downward strain of the arch.

It will be seen that this form of bar is very simple and economical in construction while embodying the greatest efficiency in use. This bar, although described in connection with arch and column construction, is adapted for use in any character of metal, reinforced concrete, or cement construction.

Having now described my invention and set forth its merits, what I claim, and desire to secure by Letters Patent, is—

1. A concrete reinforcing consisting of a bar having a plurality of integral spurs, and a spiral coil permanently secured thereto by having the spurs bent down on the several coils, the coils extending beyond and free of the bar at the opposite side therefrom to the securing point.

2. A concrete reinforcing consisting of a bar having integral means to secure a coil thereto, and a spiral coil permanently secured to the bar in each convolution and extended beyond and free of said bar at the opposite side therefrom to the securing point.

3. A reinforcing-bar provided upon one edge with a series of kerfs each having an integral overlapping spur, and a coil disposed in said kerfs, each convolution thereof being retained beneath one of said spurs.

4. In a reinforcing-bar, a spiral coil permanently secured thereto by spurs bearing on each convolution thereof and extended beyond and free of said bar at the opposite side therefrom to the securing-point, said coils being deflected in opposite directions from the center of the bar toward the ends thereof.

5. A reinforcing-bar provided upon one edge with a series of kerfs disposed diagonally to the length of the bar each having an overlapping integral spur projected toward the center of the bar, and a coil disposed in said kerfs and retained beneath said spurs.

6. A reinforcing bar provided with a spirally-disposed coil secured thereto and extended free of said bar, and a secondary spirally-disposed coiled strand secured to the bar and extending in the opposite direction to the first mentioned coil.

7. A reinforcing-bar provided at opposite sides of its center with spiral coils secured thereto and deflected in opposite directions from the center of the bar, and a secondary spiral coil secured to the bar and extended in the opposite direction to the first-mentioned coil throughout the length thereof.

In testimony whereof I have hereunto set my hand this 24th day of June, 1916.

GEORGE E. VANDENBURGH.

No. 841,741. PATENTED JAN. 22, 1907.

G. E. VANDENBURGH.

REINFORCING BAR.

APPLICATION FILED MAY 8, 1906.

Fig. 1.

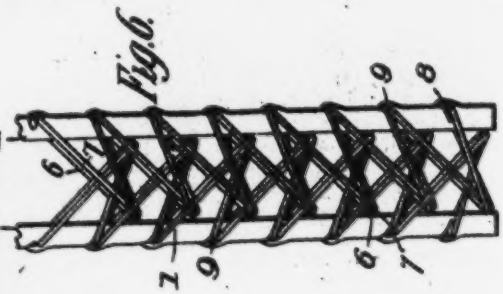


Fig. 6.

Fig. 5.

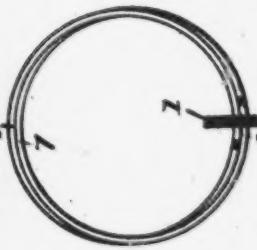


Fig. 2.

Fig. 3.

Fig. 4.

WITNESSES:

H. G. Coyle.

Alfred I. Gage

INVENTOR

George E. Vandenburgh,

BY E. B. Stocking

Attorney

UNITED STATES PATENT OFFICE.

GEORGE E. VANDENBURGH, OF WASHINGTON, DISTRICT OF COLUMBIA.

REINFORCING-BAR.

No. 841,741. Specification of Letters Patent. Patented Jan. 22, 1907.

Application filed May 9, 1906. Serial No. 315,959.

To all whom it may concern:

Be it known that I, GEORGE E. VANDENBURGH, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Reinforcing-Bars, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to a reinforcing-bar particularly adapted for cement and concrete construction wherein the bar is embedded in the plastic body to be supported thereby.

The invention has for an object to provide a reinforcing-bar with one or more spirally-disposed coils secured to the bar so as to provide an extended area of contact adapted to resist strain longitudinally and laterally of the bar and to form a truss within the body of concrete or other plastic material which provides the maximum of supporting strength in the arch or surface to be formed.

Other and further objects and advantages of the invention will be hereinafter set forth, and the novel features thereof defined by the appended claims.

In the drawings, Figure 1 is a vertical section showing the bar applied to supporting girders or beams. Fig. 2 is an enlarged vertical section on the line 2 2, Fig. 1. Fig. 3 is a detail perspective of the primary and secondary coils shown in Fig. 1. Fig. 4 is a similar view of a modified form using one coil. Fig. 5 is a detail plan of the form shown in Fig. 3, and Fig. 6 is an elevation of two meshing coils used for girder and column construction.

Like numerals of reference indicate like parts in the several figures of the drawings.

The numeral 1 designates a bar which may be of any desired construction or configuration and supported in any preferred manner. For instance, when used in arch construction it is adapted to rest upon the base of the beams or girders 2 sufficiently above the lower surface thereof to provide for the facing of the concrete or cement beneath the lower face of the bar. The coils 4 are secured to the bar in any desired manner—for instance, as hereinafter described—and the plastic material or cement-filling 5 applied so as to surround the coils and bar and embed the same therein to form a truss construction.

The bar may be provided with a primary coil 6, extending in one direction, as shown in Fig. 4, which is sufficient in light construction; but when a heavier construction is to be used a secondary coil 7 is provided, which extends in the opposite direction to the coil 6 and through the same so as to cross beneath the coil 6 at a point directly above the bar, thus providing a construction in which all lateral pull or strain of the coil is avoided, owing to the equalization thereof by the oppositely-extending coils and the tendency of the coils to move or flatten toward the face of the bar resisted. This preferred construction is shown in Figs. 1 and 3, and it is also desirable that both of the coils be deflected away from the center of the bar, as shown in Fig. 1, as the greatest supporting strain carried by the arch is at the center thereof, and this deflection therefore resists such strain and tends to draw the coils upward into a position at right angles to the bar.

As a preferred means of securing the coils to the bar I have shown a series of kerfs 8 in one face of the bar inclined away from the center of the bar toward the opposite ends thereof, and the coils are seated within these kerfs and held therein by means of the integral spurs 9, which are forced downward upon the coils when inserted and permanently retain them in position.

In Fig. 6 a modified application of the invention is shown where two of the bars are disposed parallel to each other, with their coils intermeshing, for use in column or girder construction, wherein such a construction provides the maximum of strength with the minimum of weight in the reinforcing material.

In the operation of the invention it will be seen that the bar supporting the coil resists any movement thereof longitudinally of the bar and provides the necessary strength upon which the truss structure formed by the coils is carried. These coils being extended in opposite directions and embedded in the material provide the maximum strength to resist either lateral or longitudinal pressure with the minimum weight and quantity of material, as owing to their opposite direction of curvature they effectually oppose the strain placed thereon, while their deflection toward the opposite ends of the bar resists the central downward strain of the arch.

It will be seen that this form of bar is very simple and economical in construction,

while embodying the greatest efficiency in use. This bar, although described in connection with arch and column construction, is adapted for use in any character of metal, reinforced concrete, or cement construction.

Having now described my invention and set forth its merits, what I claim, and desire to secure by Letters Patent, is—

1. In a reinforcing-bar, a spiral coil rigidly secured thereto at two points in each convolution thereof and extended beyond and free of said bar at the opposite side therefrom to the securing-point.

2. In a reinforcing-bar, a spiral coil rigidly secured thereto at two points in each convolution thereof and extended beyond and free of said bar at the opposite side therefrom to the securing-point, said coils being deflected in opposite directions from the center of the bar toward the ends thereof.

3. A reinforcing-bar provided upon one end with a series of kerfs each having an integral overlapping spur, and a coil disposed in said kerfs, each convolution thereof being retained beneath one of said spurs.

4. A reinforcing-bar provided upon one edge with a series of kerfs disposed diagonally to the length of the bar each having an overlapping integral spur projected toward the center of the bar, and a coil disposed in said kerfs and retained beneath said spurs.

5. A reinforcing-bar provided with a spirally-disposed coil secured thereto and extended free of said bar, and a secondary spirally-disposed coiled strand secured to the bar and extending in the opposite direction to the first-mentioned coil.

6. A reinforcing-bar provided at opposite sides of its center with spiral coils secured thereto and deflected in opposite directions from the center of the bar, and a secondary spiral coil secured to the bar and extended in the opposite direction to the first-mentioned coil throughout the length thereof.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE E. VANDENBURGH.

Witnesses:

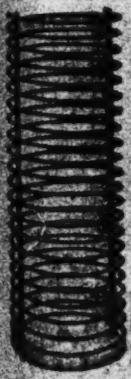
ALFRED T. CAGE,

JOHN L. FLETCHER.

Plaintiff's Exhibit
No. 4. Pages 26 and 27
Kahn Building Products

Stack of Column Hooping (collapsed) ready for shipment. Note compactness and simplicity.

COLLAPSIBLE COLUMN HOOPING



Collapsible Column Hooping for reinforcing concrete columns, is shipped in the form of flat, circular coils of exact diameter and accurately spaced by means of special spacing bars. These coils spring automatically into a complete hooped column on cutting the small fastening wires.

Rib Bars are ordinarily used as vertical reinforcements in conjunction with Column Hooping.

Sizes of Collapsible Column Hooping

Shipped complete with two spacing bars.

Sizes of wire for hooping: ¼-inch, 5/16-inch, ⅜-inch, 7/16-inch and ½-inch diameter.

Diameter of Coils: 9-inch to 36-inch.

Pitch: 1¼-inch to 12-inch.

Hooping, where desired, can also be furnished in bundles, coiled to the correct diameter, and with separate spacing bars, ready for assembling in the field.

See Table of Safe Loads Carried on Hooped Columns on next page.

SAFE LOADS CARRIED BY HOOPED COLUMNS

Size and Grade of Rods	Outside Diameter	Core Diameter	Number of Vertical Rods	Safe Load	Spacing of Hooping Wire Centers	Pitch of Hooping

Concrete adjacent the core shown should be 1/12th [illegible] for the hooped columns, based on [illegible] strength for concrete [illegible] bearing surface on [illegible] of column should not exceed 1/4th of its diameter [illegible].

[illegible] must be made for concrete footing, bearing [illegible].

SAS

Washington, D. C.

Sir, you are invited to be present at

The New Freedman's Hospital Building,

Monday, June 25th, 1906, at 3 o'clock P. M.

to witness a

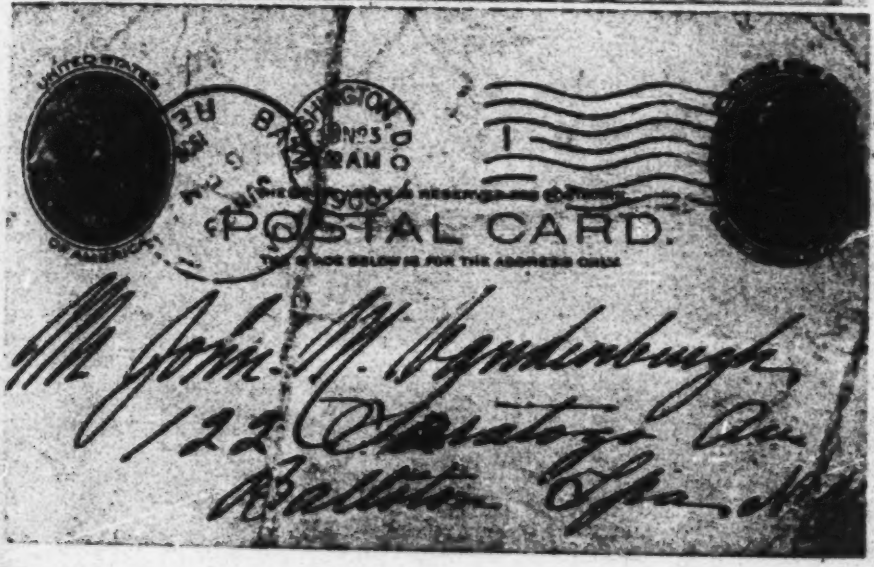
Crushing Test of the Vandenburgh Reinforced Concrete System,

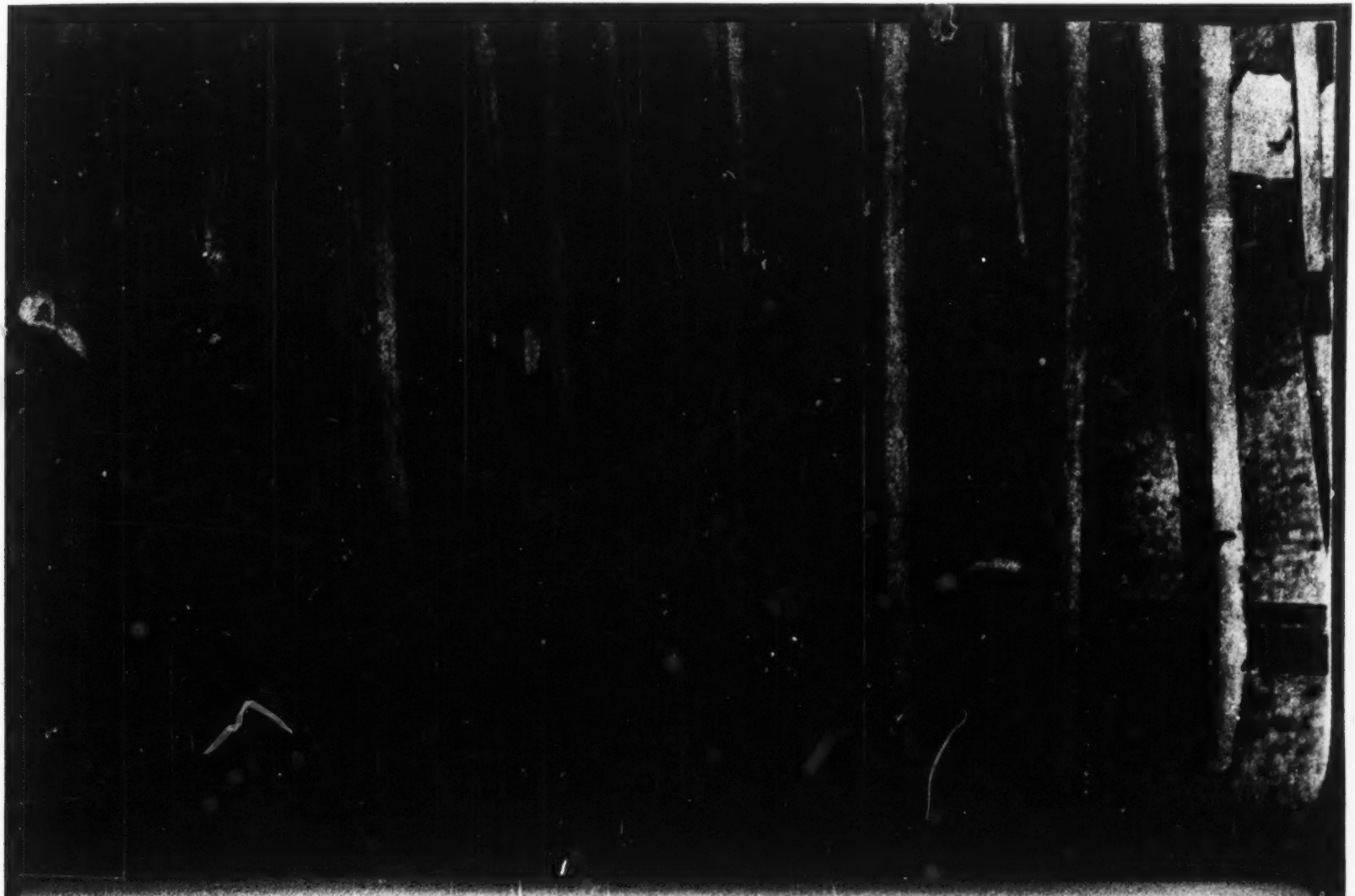
under the direction of the Consulting Engineers of the Building Department.

No. [illegible]

Respectfully,

Benjamin Stehgn.



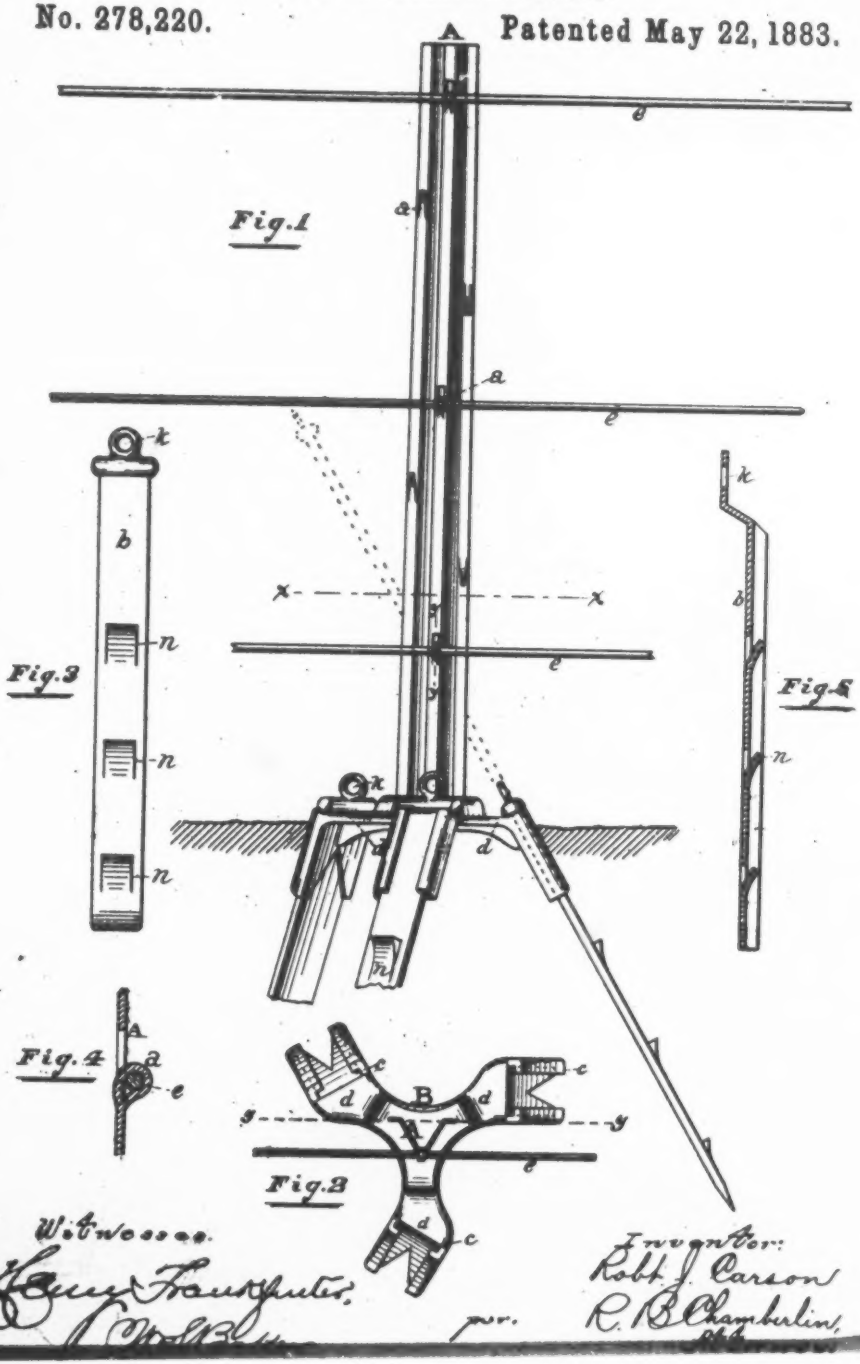


(No Model.)

R. J. CARSON.

IRON OR STEEL FENCE POST.

No. 278,220. Patented May 22, 1883.



Witnesses.

Inventor:
Robt. J. Carson
per. R. B. Chamberlin,

UNITED STATES PATENT OFFICE.

ROBERT J. CARSON, OF CHICAGO, ASSIGNOR OF ONE-HALF TO EDWARD RUTZ, OF SPRINGFIELD, ILLINOIS.

IRON OR STEEL FENCE-POST.

SPECIFICATION forming part of Letters Patent No. 278,290, dated May 22, 1883.

Application filed April 24, 1883. (No model.)

To all whom it may concern:

Be it known that I, ROBERT J. CARSON, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Iron or Steel Fence-Posts; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to an improvement in fence-posts, being particularly designed for the construction of barbed-wire fences; and it consists of a post that is formed from sheet metal, that is secured to a base having radial arms, which arms have at their outer ends downwardly-projecting annular bearing-grooves, in combination with pegs or braces of suitable construction, that are adapted to be driven through the grooves and into the ground for securing the posts thereto, the posts being provided with suitable means for attachment of the barbed wire, as will be more fully described hereinafter.

In the accompanying drawings, Figure 1 is a side elevation of a fence-post with its attachments complete. Fig. 2 is a cross-section on the line X X of Fig. 1. Figs. 3, 4, and 5 are detail views.

A represents a post formed of sheet metal, of any suitable thickness, and which is preferably triangular in cross-section, as shown in Fig. 2. This post is secured in any suitable manner to the base-plate B, which base-plate has projecting from it the radial arms D, the outer ends of which are inclined at a suitable angle downward, and have their inner sides in a line with the adjacent side of the angle formed by the post, as shown at Y Y, Fig. 2. These downwardly-turned projections are provided with a suitable groove, *c*, which adapts them to receive the pegs *b*, that are adapted to be driven through them and forced into the ground for securing the post in position. In order to anchor these pegs more firmly in position when driven into the ground, they are provided with barbs *a*, which may be either stamped out from the pegs, (which are preferably made of flat sheet metal,) or they may be cast thereon, if preferred. The tops of these pegs have secured to them the rings K, through which a crow-bar may be passed to secure leverage when it is desired to draw the pegs from the ground in order to remove the post. In order to secure the barb-wires to the post, I provide the post with ears *a*, which may be stamped therefrom or riveted thereto, and which ears are adapted to be bent over the wire *e*, as shown in Fig. 4.

A fence-post thus constructed is light, and is cheaply made, will be found exceedingly durable, and may easily be removed, after having been put in position, when it is desired to move the fence.

Having thus described my invention, I claim—

1. The combination of a fence-post of suitable construction, a base-plate, B, provided with radial arms *d*, turned-down ends having grooves *c* formed in them, and pegs *b*, that are adapted to secure the base-plate in position by being driven through the grooves, with which they are provided, into the ground, substantially as described.

2. The combination of the post A, formed of sheet metal, and provided with ears *a* for securing the wires thereto, a base-plate, B, having radial arms *d*, and the turned-down ends having grooves *c*, these ends being arranged so as to have their inner sides in a line with the adjacent side of the fence-post, and pegs *b*, that are adapted to be driven through the grooves and into the ground for securing the base-plate in position, the said pegs being provided with barbs, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

ROBERT J. CARSON.

Witnesses:
A. B. TALLMAN,
WILLIAM H. MCGUIRE.

B. F. RANDALL.

SHEET METAL FENCE POST.

No. 349,603. Patented Sept. 21, 1886.

Fig. 1.

Fig. 2.

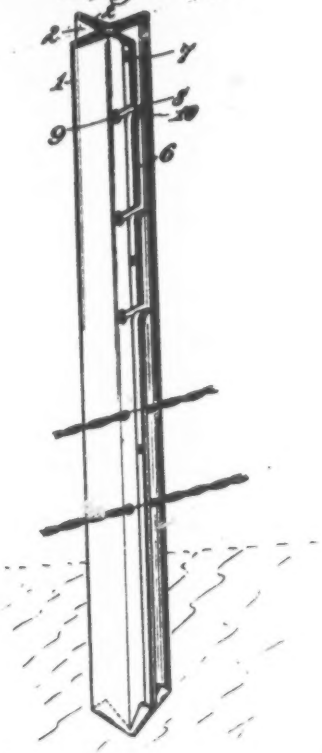


Fig. 3.

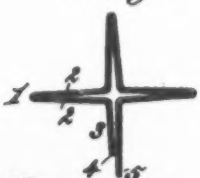


Fig. 4.

Fig. 5.

Witnesses.
Robt Errett
J. A. Rutherford

Inventor.
Benjamin F. Randall.
By James L. Norris.
Atty

UNITED STATES PATENT OFFICE.

BENJAMIN F. RANDALL, OF FALL RIVER, MASSACHUSETTS.

SHEET-METAL FENCE-POST.

SPECIFICATION forming part of Letters Patent No. 349,603, dated September 21, 1886.

Application filed July 15, 1886. Serial No. 208,095. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN F. RANDALL, a citizen of the United States, residing at Fall River, in the county of Bristol and State of Massachusetts, have invented new and useful Improvements in Sheet-Metal Fence-Posts, of which the following is a specification.

The object of my invention is to provide a novel and comparatively inexpensive metallic post for erecting wire fences, which will require no painting, is strong but light, can be easily driven in the ground, is substantial when in place, and the wire strands can be secured thereto in a very simple manner.

To such ends my invention consists in a fence-post consisting of a single sheet of galvanized metal bent, folded, and creased into cruciform shape in cross-section, constituting radial flanges each comprising two parallel thicknesses of the metal, the longitudinal ends of the sheet of metal comprising one flange being lapped or bent one around the other and united together to form a bead, said beaded flange having slots extending from the edge inward the full depth of the flange, in such manner that when the wire strands are introduced into the slots and confined in place they will have bearing against two of the radial flanges at opposite sides of the flange to which they are attached.

The invention consists of other features, which will be hereinafter described and claimed, reference being made to the accompanying drawings illustrating the invention, in which—

Figure 1 is a perspective view of my improved metallic fence-post, showing the same prior to one longitudinal edge of the sheet metal being folded around the other edge, and before the lower ends of the flanges are folded on inclined lines to produce the pointed end; Fig. 2, a perspective view of the post complete, showing two wire strands secured in place; Fig. 3, a transverse sectional view of Fig. 1; Fig. 4, a transverse sectional view of Fig. 2; Fig. 5, a perspective view of a wooden cap-piece for the post.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail. I first provide a rectangular sheet of galvanized sheet metal, and by appropriate mechanism bend and fold the same to form longitudinal creases, 1, and in such manner as to constitute four radial flanges, making the post cruciform in cross-section, each flange comprising two parallel thicknesses, 2 2, of the sheet of metal. The longitudinal edges of the metal sheet which comprise one flange, 3, are so formed that one edge extends beyond the outer edge, 4, thereby constituting a flange or lip, 5, which is subsequently folded around and upon the edge 4, forming a bead, 6, as shown in Figs. 2 and 4. To permanently secure the flange or lip it is riveted, as at 7; but obviously it may be soldered instead of riveted, it only being essential to firmly and permanently secure it in place. The construction is such that all the creases 1 are brought into close proximity to each other at the axis of the post, just leaving sufficient space to receive the tongue of a wooden block, hereinafter referred to. The construction is such that by lapping the longitudinal flange or lip 5 around the other edge 4 the flange 3 becomes somewhat less in width than the other flanges. The lower end of the post is pointed so that it can be readily driven into the ground by folding the two thicknesses 2 2 of each flange on an inclined line, as indicated by the dotted lines *a*, Fig. 1, such folded parts being pressed down upon their respective flanges, thereby bringing the lower end of the post into the form shown in Fig. 2, so that the penetrating end comprises a hemmed edge of thickness of metal, to provide the strength requisite in driving the post into place. The folding or hemming of the ends also provides closed inclined edges for penetrating the ground, so that no earth can enter between the thicknesses comprising the radial flange. The post being formed as set forth, the short beaded flange 3 is slitted at several points along its length, as at 8, which slits extend the complete width of the flange and terminate at their inner ends in orifices 9 to receive the wire strands. The slits are preferably arranged at an angle to form lips 10, which can be bent laterally from the face of the flange to permit the insertion of the wire strands into the orifices 9, after which the lips 10 are restored to their original position by suitable means, thereby confining the wires in place. To further secure the wires I solder them to the post at the orifices 9, or attach the strands to the post

by a piece of galvanized wire securely wound around the strand on both sides of the flange, one end of said wire being passed through the hole below and the two ends tightly twisted together. It will be observed that as the wire receiving and holding orifices are at the base of the short flange, the wire strands have bearing against two of the other radial flanges at opposite sides, respectively, of the short flange, thereby materially and substantially increasing the stability of the fence when erected. The slits by passing through the beaded edge of the flange 3 constitute strong and to some extent rigid lips 10, which is of advantage in that they are not liable to be accidentally moved laterally, which would permit the wire strand to be misplaced from its seat. By employing galvanized sheet metal I provide a metallic post which requires no painting, and the entire construction provides a post which is light, but substantial, and which can be readily driven into the ground and easily removed therefrom when necessary.

It is sometimes desirable and necessary to use a top wooden or similar rail upon barbed wire fences, and to admit this I employ a wooden block, 11, Fig. 5, having a wedge-shaped tongue, which is inserted in the open top of the post, and to which may be nailed a strip of board, for the purpose of turning stock without injury at night.

What I claim is—

1. A fence-post consisting of a sheet of metal bent, folded, and creased to form radial flanges, each comprising two parallel or approximately parallel thicknesses of the metal with the longitudinal ends of the sheet metal comprising one flange bent around the other and firmly secured in place, the lower ends of the flanges being bent on inclined lines and folded down upon said flanges to form hems and a pointed end to the post, substantially as described.

2. A fence-post consisting of a sheet of metal bent, folded, and creased to form radial flanges, each comprising two parallel or approximately parallel thicknesses of the metal with the longitudinal ends of the sheet metal comprising one flange bent one around the other and firmly secured to form a beaded flange, said beaded flange having slits extending its full width to receive the wire strands, whereby the latter have bearings against two of the radial flanges at opposite sides of the slitted flange, substantially as described.

3. A fence-post consisting of a sheet of metal bent, folded, and creased to form radial flanges, each comprising two parallel or approximately parallel thicknesses of the metal with the longitudinal ends of the sheet metal comprising one flange bent one around the other and firmly secured to form a beaded flange having slits extending its full length to receive the wire strands, said flanges having one of their ends folded on inclined lines to form a hemmed pointed end, substantially as described.

4. A metallic post consisting of a sheet of metal bent, folded, and creased to form radial flanges, each comprising two parallel or approximately parallel thicknesses of the metal, said flanges being folded at one end on inclined lines to form a hemmed pointed end, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

BENJAMIN F. RANDALL.

Witnesses:

JOHN N. BURGESS,

HENRY H. EARL.

(No Model.)

L. B. HARMON & J. N. NUTT.

FENCE POST.

No. 380,627. Patented Apr. 3, 1888.

Fig. 1.

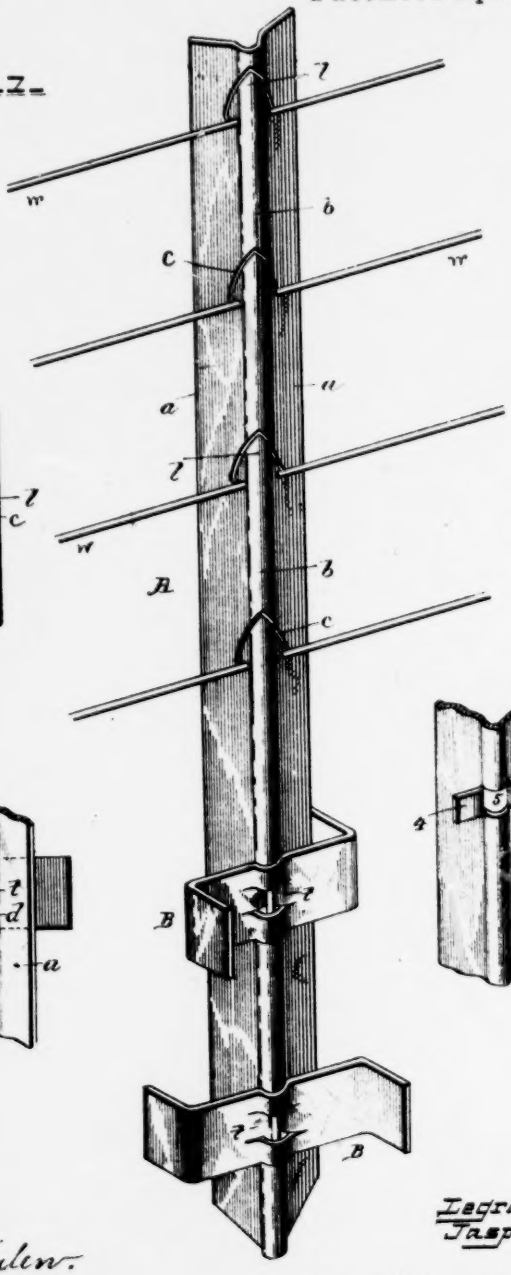


Fig. 4.

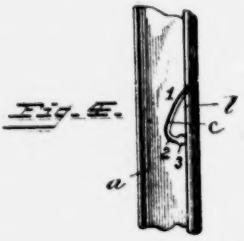


Fig. 2.

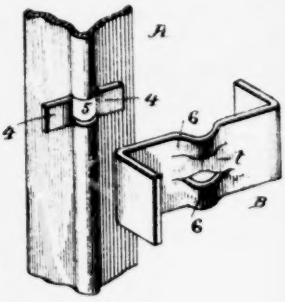
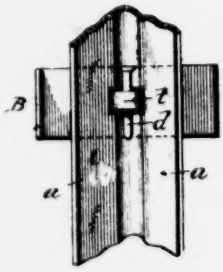


Fig. 3.



Witnesses

Albert Speulen.

Robert Owens,

Inventors

Legrand B. Harmon.

Jasper N. Nutt.

By their Attorneys

Anderson & Mason.

UNITED STATES PATENT OFFICE.

LEGRAND B. HARMON, OF CARYSVILLE, AND JASPER N. NUTT, OF SIDNEY, OHIO.

FENCE-POST.

SPECIFICATION forming part of Letters Patent No. 380,627, dated April 3, 1888.

Application filed January 30, 1888. Serial No. 262,620. (No model.)

To all whom it may concern:

Be it known that we, LEGRAND B. HARMON, of Carysville, Champaign county, Ohio, and JASPER N. NUTT, of Sidney, Shelby county, Ohio, citizens of the United States of America, have invented certain new and useful Improvements in Fence-Posts, of which the following is a specification, reference being had therein to the accompanying drawings.

Our invention relates to fence-posts for wire fences; and it consists in certain details of construction, which will first be described in connection with the accompanying drawings, and then pointed out in the claims.

Figure 1 of the drawings is a perspective view of our post with two anchors attached. Fig. 2 is a perspective view of an anchor and a portion of the post. Fig. 3 is a rear elevation of a portion of the post with an anchor attached. Fig. 4 is a side view of a portion of the post, illustrating the wire-receiving kerfs.

Referring to the drawings, A represents the post, stamped up from metal, and for the purpose of description it may be said to be V-shaped in cross-section. The front edge of the post, however—that is to say, the edge to which the sides *a a* converge—is rolled up into a nearly half-round bead, *b*, the function of which bead, aside from giving strength to the post, will be presently explained.

For the purpose of attaching the fence-wires *w* to the post, we cut kerfs *c* in its front edge, which kerfs incline downward and rearward, as at 1, then forward, as at 2, and finally terminate in perforations, as at 3, Fig. 4, in which latter the wires are to be inserted. It will be noticed that these wire-receiving perforations 3 are located at the rear of bead *b*, and that consequently the lip *l*, formed by the kerf, will, owing to the comparative rigidity of the bead, be caused to spring back with considerable force after the wire has been passed down through the kerf and forward into the perforation, whereby the wire will be securely held without the interposition of wedges or other like devices, it being understood that the diameter of the perforation is somewhat less than that of the wire; and it will also be noticed that by reason of the bead we are enabled to make this very desirable form of kerf without cutting so deep into the post as to materially weaken it.

For the purpose of maintaining the post in an erect position when in the ground, we employ one or more anchors, B, removably secured to the front edge of the post. This anchor we prefer to make in the form shown in the drawings—that is to say, by bending the respective ends of a rectangular piece of metal in opposite directions. An anchor of this form, when attached to the post, offers greatly-increased resistance to deflection of the post in any and all directions, as will be readily apparent on inspection of Fig. 1 of the drawings.

In order to attach the anchor to the front edge of the post, and at the same time to give it a broad bearing, so that it cannot swing out of position, we cut two transverse slits through the bead on the post and a short distance into the sides *a a*, and then sever the intermediate portion by a vertical cut down the center of the bead, after which we bend back each severed portion into a position at right angles to the axis of the post, thus forming bearings or anchor-braces 4 and leaving an opening, 5, for the reception of the tongue on the anchor. This tongue *t* is formed by cutting two parallel slits, 6, in the anchor and bending the intermediate portion rearward into concave form, as viewed from the front, and the other portions on each side of the tongue into convex form, so that while the tongue passes rearwardly through the opening 5 in the post the convex parts will fit neatly around the bead. A wedge, *d*, or other suitable device is then inserted between the tongue and the rear side of the bead, as seen in Fig. 3, which serves to key the anchor to the post.

One anchor will generally be found sufficient to secure the post; but two or more may be used if the nature of the soil demands them.

By the above description our invention is clearly distinguished from the V-shaped post having oblique kerfs cut across its front edge, which kerfs terminate directly in apertures for the reception of the wire, for by that construction there is little or no resiliency in the lip, and therefore, in order to hold the wire firmly,

it has been found necessary to either wrap it around posts at intervals or to secure it to each post by means of wedges and like devices.

We are aware that an anchor made from a rectangular piece of metal with its ends bent in opposite directions from each other is not new; but we believe we are the first to combine this desirable form of anchor with a beaded V-shaped post.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A metallic V-shaped fence-post with an approximately semi-cylindrical bead on the edge formed by the meeting of the sides, having a series of wire-securing lips on said edge, the said lips being formed by downwardly and rearwardly inclined and forwardly-extending kerfs terminating in perforations in rear of the bead, substantially as described.

2. The combination, with a V-shaped metallic fence-post having an approximately semi-cylindrical bead on the edge formed by the meeting of the sides, an opening through said beaded edge, and an anchor-brace integral with the post on each side of said opening, of an anchor having a rearwardly-extending tongue to pass through the opening in the post and a key or other suitable device to pass between the tongue and the rear side of the bead, substantially as described, and for the purposes stated.

3. The combination, with a V-shaped metallic fence-post having an approximately semi-cylindrical bead on the edge formed by the meeting of the sides, an opening through said beaded edge, and an anchor-brace integral with the post on each side of said opening, of an anchor formed from a rectangular piece of metal having its ends bent in opposite directions and having an integral rearwardly-extending tongue to pass through the opening in the post, and a key or other suitable device to pass between the tongue and the rear side of the bead, substantially as described, and for the purposes stated.

In testimony whereof we affix our signatures in presence of two witnesses.

LEGRAND B. HARMON.
JASPER N. NUTT.

Witnesses:
H. WILSON,
B. W. GILFILLAN.

No Model.)

S. B. SALSICH.

FENCE POST.

No. 417,397. Patented Dec. 17, 1889.

Fig. 1.

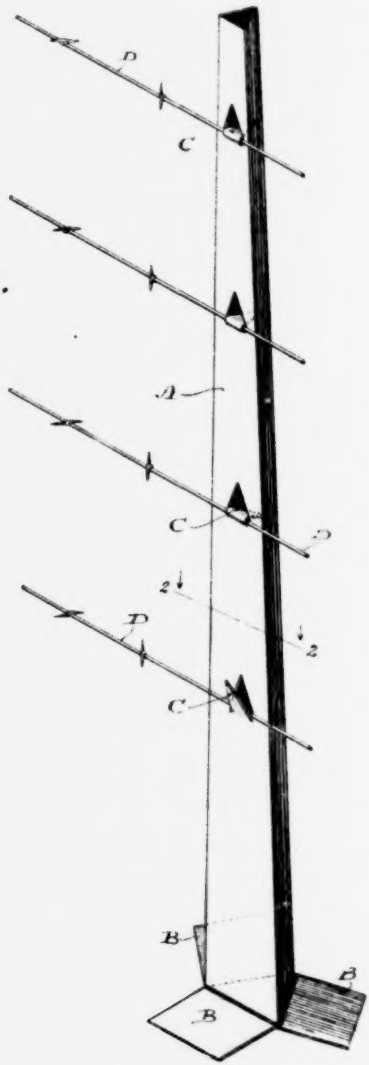
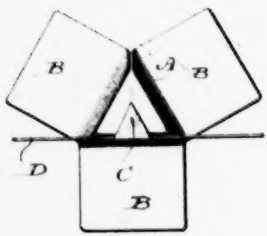


Fig. 2.



Witnesses
Geo. W. Young.
N. E. Oliphant

Inventor
Sherman B. Salsich
By Stout Underwood
Attorneys

UNITED STATES PATENT OFFICE.

SHERMAN B. SALSICH, OF MILWAUKEE, ASSIGNOR OF ONE-HALF TO WILLIAM E. RUSSELL, OF HARTLAND, WISCONSIN.

FENCE-POST.

SPECIFICATION forming part of Letters Patent No. 417,397, dated December 17, 1889.

Application filed December 10, 1888. Serial No. 293,202. (No model.)

To all whom it may concern:

Be it known that I, SHERMAN B. SALSICH, of Milwaukee, in the county of Milwaukee, and in the State of Wisconsin, have invented certain new and useful Improvements in Fence-Posts; and I do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates to posts for wire fences; and it consists in certain peculiarities of construction and combination of parts, to be hereinafter described with reference to the accompanying drawings and subsequently claimed.

In the drawings, Figure 1 represents a perspective view of a fence-post constructed according to my invention, and Fig. 2 a horizontal section on line 2 2 of the preceding figure.

Referring by letter to the drawings, A represents my improved post, the same being made from flexible sheet metal, preferably galvanized iron.

The blanks for the post are tapered, as is evident from the finished article shown by Fig. 1. Each blank is slitted at the lower end, in order that certain portions of the metal can be bent up at right angles to form lateral ears B, that correspond in number to the sides of the post and serve as supports or anchors for the finished post, and along its length said blank is stamped out at certain intervals to form clips C, the latter being preferably of triangular shape. The main portion of the blank is bent to form a triangle in horizontal section, and while I have shown only one face of the triangle provided with the clips C it is obvious that two or all of said faces may be thus provided, should such a construction be found necessary or desirable.

The strands D of the fence-wire are laid between the clips C and the adjacent face of the post and said clips bent in and down, thereby clamping said wire firmly in place.

By the construction above described I provide a very light and durable post, that can be manufactured and sold at a comparatively low price.

Another advantage of my invention lies in the fact that the blanks for the posts can be packed in lots, so as to economize space in the matter of storage and transportation, as no skilled labor is requisite to bend said blanks into shape for use as posts.

I am aware that sheet-metal fence-posts of various patterns have been made, and that the clips for securing the strands of wire to such a post are not new, and such I do not claim.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

A sheet-metal fence-post tapered as to length and triangular in horizontal section, the lower end of the post split upward for a certain distance at the corners, and the metal between slits bent out at right angles to the post to form lateral ears, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand, at Milwaukee, in the county of Milwaukee and State of Wisconsin, in the presence of two witnesses.

SHERMAN B. SALSICH.

Witnesses:
N. E. OLIPHANT,
WILLIAM KLUG.

(No Model.)

P. MILES.

WIRE LATH.

No. 429,935. Patented June 10, 1890.

Fig. 1.

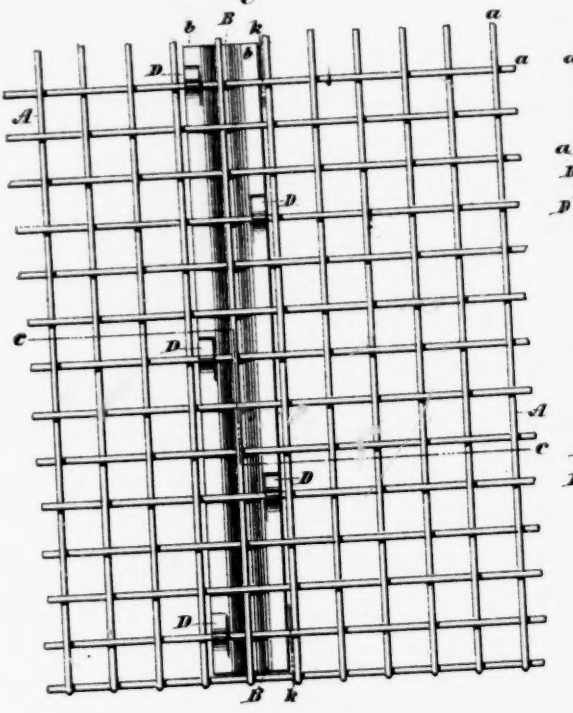


Fig. 2.

Fig. 3.

Fig. 4.

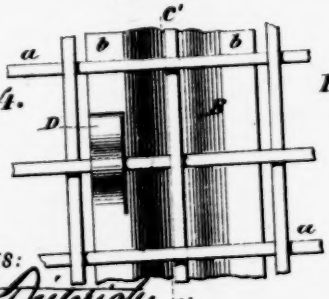
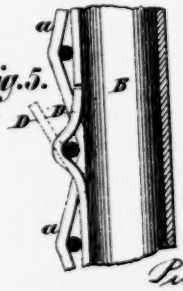


Fig. 5.



WITNESSES:

Gustave Patterich.

C'

C. Augustus Knight

INVENTOR

Punches Miles

BY Briesen & Knauth

ATTORNEYS

UNITED STATES PATENT OFFICE.

PURCHES MILES, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE CLINTON WIRE CLOTH COMPANY, OF CLINTON, MASSACHUSETTS.

WIRE LATH.

SPECIFICATION forming part of Letters Patent No. 429,935, dated June 10, 1890.

Application filed December 3, 1889. Serial No. 332,369. (No model.)

To all whom it may concern:

Be it known that I, PURCHES MILES, a resident of Brooklyn, Kings county, and State of New York, have invented certain new and useful Improvements in Wire Laths, of which the following is a specification.

Heretofore wire lath, which usually consists of wire-cloth, has been stiffened by bars or strips secured to the lath by metal clips or by weaving in. This stiffening is called "furring." It is expensive to apply the furring or stiffeners to the wire lath by means of clips, because, as far as I am aware, it has always been done by hand.

The object of my invention is to so simplify and improve the connection between the stiffening strips or furring and the wire-cloth as to materially reduce the cost of the wire lath, while improving the whole structure.

The invention consists in the combination, with the wire cloth or lath, of a stiffening strip or piece consisting of a U-shaped bar having flanges and in said flanges lips formed integral therewith and laid along the lath, said lip being folded over a wire of the cloth or lath, whereby the cloth and strip are secured together in a simple and effective manner.

The invention further consists in the novel details of improvement that are more fully hereinafter set forth, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, which form part of this specification, wherein—

Figure 1 is a face view of a piece of wire lath embodying my invention; Fig. 2, a section through *k k* of Fig. 1; Fig. 3, a section along the line *c c*, Fig. 1; Fig. 4, a detail view of the U-shaped stiffener, showing the method of its fastening to the wire lath; and Fig. 5, a longitudinal section along the line *c' c'*, Fig. 4.

Similar letters throughout the several views indicate similar parts.

A represents a piece of wire-cloth composed of strands *a*, woven into substantially the shape shown in Fig. 1.

B represents a U-shaped bar having flanges *b b*, in which flanges lips D D are cut at suitable places. These lips are adapted to inclose the strands *a* of the wire-cloth, and when bent down upon the strand hold the stiffener securely in place. The U-shaped bar or stiffener is preferably struck out of sheet metal—such as iron—for the reason that such material is much cheaper and lighter. The lips D D are cut, as shown in the drawings, on both of the flanges *b b*, substantially as shown in Figs. 1 and 4. The stiffener after it has been cut upon its flanges according to my invention has lips projecting upward, as shown in dotted lines in Figs. 2 and 5, and after the stiffener has been pushed upon the wire-cloth the strands are held in these lips, and the lips are pressed down by machinery or other suitable means, and thus the stiffener and wire-cloth are firmly held together. In the drawings these lips are cut on opposite sides alternately—that is, the first lip incloses a strand on the left side of the groove in the stiffener, and the second lip holds a strand in the right side of the stiffener below the first lip. This is not necessary, for it is obvious that the lips may be placed side by side—that is, the first and second lips may inclose the same strand, my invention being an improved wire lath, consisting of wire-cloth having a stiffener which is grooved or U-shaped with flanges on opposite sides of the groove and with lips in these flanges whether placed side by side or alternating, said lips being adapted to pass through the mesh of the wire-cloth and to be folded or laid over the strands of said cloth, and thus securely attach itself to the wire-cloth.

I am aware that grooved or U-shaped stiffeners have been used in wire lathing, but they have been fastened by means of clips entirely separate from the stiffener.

In my improved lathing the lips or fasteners for the stiffener are integral with the stiffener, being cut in the flanges and struck upward.

The advantages of my improved construction of wire lathing are that the stiffener may be fastened to the wire lathing by means of machinery and held securely in place by reason of the lips engaging the strands. There is little or no hand-work required and no extra material to be wasted.

Having now described my invention, what I desire to claim and secure by Letters Patent is as follows:

1. A stiffener for wire cloth or lath, consisting of a grooved or U-shaped bar having flanges on opposite sides, and lips in said

flanges, extending substantially parallel with the length of the bar and projecting outwardly from said flanges, said lips being adapted to pass simultaneously through the mesh of a wire cloth or lath and to be folded or laid over the strands of said cloth or lath to confine said wires between the bar or flanges and the lips, substantially as described.

2. A stiffener for wire cloth or lath, consisting of a grooved or U-shaped bar having flanges on opposite sides, and lips in said flanges, said lips alternating on opposite sides of the bar and extending substantially parallel with the length of the bar, and adapted to engage the strands of the wire cloth or lath, substantially as described.

3. A stiffener for wire-cloth, consisting of a grooved or U-shaped bar having flanges on opposite sides and lips in said flanges, extending substantially parallel with the length of the bar, in combination with a wire cloth or lath against which said stiffener is placed, the lips of the stiffener being folded or laid over the strands of the cloth to confine said strands between the bar or flanges and the lips, substantially as described.

PURCHES MILES.

Witnesses:
HARRY M. TURK,
HENRY E. EVERDING.

231

(No Model.)

G. W. BOND.

FENCE POST.

No. 432,930. Patented July 22, 1890.

FIG. 1.

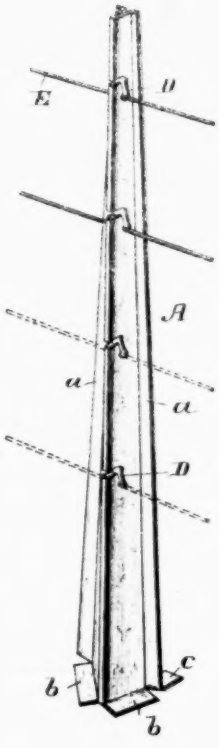


FIG. 2.

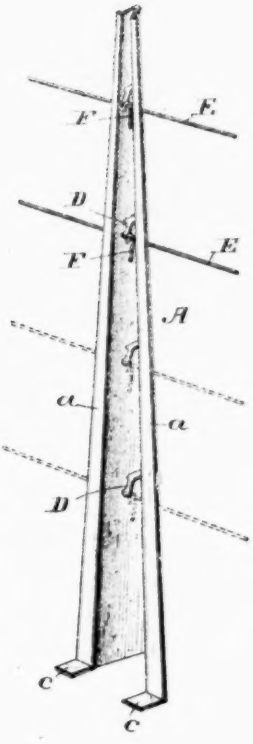
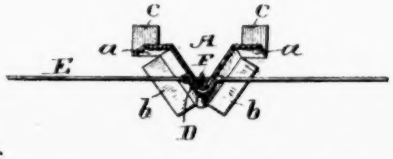


FIG. 3.



WITNESSES.

J. Henry Kaiser.

G. M. Copenhaver

INVENTOR

George W. Bond

by Franck D. Johns

his Attorney

UNITED STATES PATENT OFFICE.

GEORGE W. BOND, OF ADRIAN, MICHIGAN, ASSIGNOR TO HIMSELF, CHESTER C. VAN DOREN, AND LEVI H. ROATH, OF SAME PLACE.

FENCE-POST.

SPECIFICATION forming part of Letters Patent No. 432,930, dated July 22, 1890.

Application filed August 3, 1889. Serial No. 319,608. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. BOND, a citizen of the United States, residing at Adrian, in the county of Lenawee and State of Michigan, have invented certain new and useful Improvements in Fence-Posts; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in fence-posts, and more particularly to that class of metal fence-posts which are used in the construction of wire fences; and it consists in certain novelty in the construction of said post and the means employed for attaching the wires to the same, all of which I will now proceed to point out and describe, reference being had to the accompanying drawings, in which—

Figure 1 is a perspective of a fence-post constructed in accordance with my said invention, showing one or more wires attached to the same. Fig. 2 is a perspective taken on the opposite side of the post from that shown in Fig. 1; and Fig. 3 is a cross-section of the same, looking down.

Referring to said drawings, A represents a fence-post constructed of suitable metal and formed V-shaped in cross-section and tapering from the bottom to the top. *a* are vertical strengthening-flanges formed on each side of the V-shaped portion of the post and extending from the top to the bottom of the same. The lower end or base of said post is split, and the lower ends of the V-shaped portion of the post are bent out substantially at right angles, forming feet or supporting-flanges *b* on one side of said post. The lower ends of the flanges *a* are also bent out, forming feet or supporting-flanges *c* on the opposite side of the post from the feet *b*. The lower portion or base of the post, when in use, is preferably sunk a sufficient distance below the surface of the ground to be free from the effects of frost, and the feet or supporting-flanges of the same prevent said post from tilting or canting to either side, and at the same time forming an anchor to prevent the post from being pulled up on undulating or uneven surfaces. In the apex of the V-shaped portion of said post are formed downwardly-extending notches D, in which the wires are adapted to be secured.

E represents the wires, which are first inserted in the notches, so as to leave a space between the same and the inside of the V-shaped portion of the post. In this space a securing pin or bolt F is inserted, which locks the same in place and effectually prevents said wires from being detached from the post when said pin is in place, the shape of the notch in which said wires are placed also aiding in holding the same on the post. Instead of using a securing-pin for each wire, a long pin or rod may be used. The wires being in place, said long rod or pin may be inserted from the top of the post, passing down from said top to the bottom of the same and between said post and wires.

I am aware of the patent of Brinkerhoff, No. 189,918, granted April 24, 1877, which shows a post provided with strengthening-flanges having their lower ends bent outward at right angles and forming lips for holding the post down, and therefore I do not herein claim, broadly, a post having strengthening-flanges provided with projecting lips or anchor-feet at their lower ends; but

What I do claim as new, and desire to secure by Letters Patent, is—

The metal fence-post A, formed V-shaped in cross-section and provided with the vertical strengthening-flanges *a*, and having its base split and the lower end of the V-shaped portion of the post bent to form supporting feet or flanges *b*, and the lower ends of the flanges *a* bent to form feet or flanges *c*, located on the opposite side of the post from the flanges or feet *b*, said feet *b* and *c* being substantially at right angles to the post and its strengthening-flanges *a*, and having the notches D, for the reception of the wires, substantially as shown and described.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE W. BOND.

Witnesses:
A. E. BARAGAR,
R. B. ROBBINS.

233

(No Model.)

C. PRESCOTT & M. H. BENNETT.

SAND SCREEN.

No. 447,162. Patented Feb. 24, 1891.

Fig. 1.

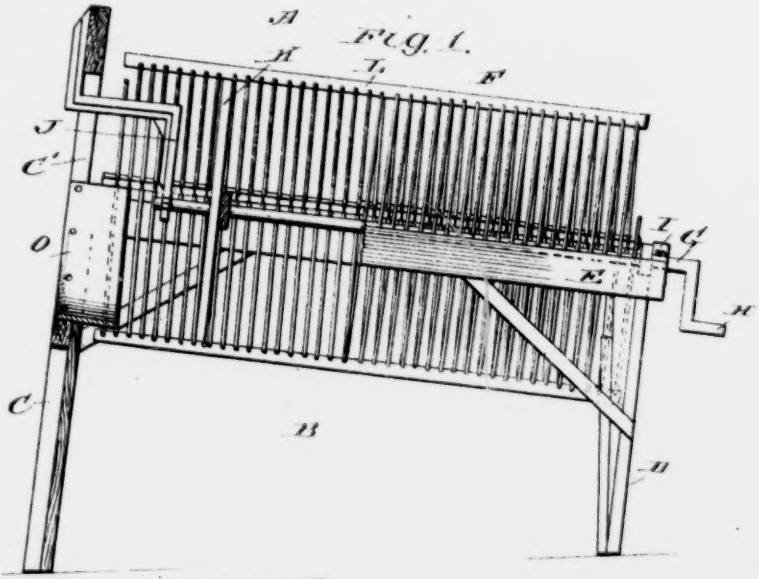


Fig. 2.

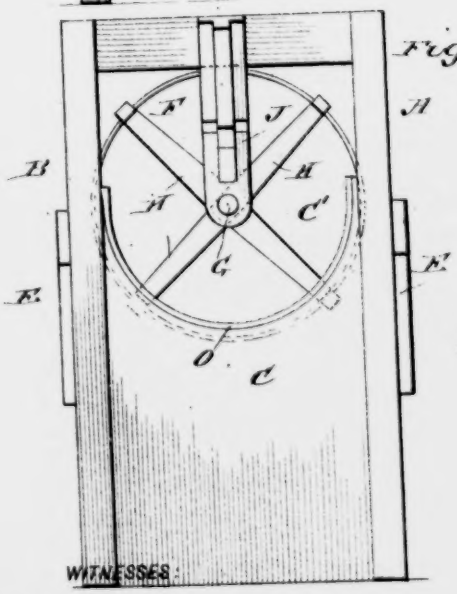
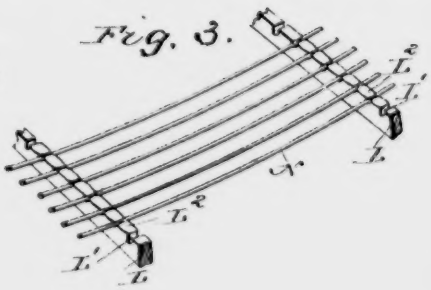


Fig. 3.



WITNESSES:

W. R. Lawrence.

E. McClark

INVENTOR:

C. Prescott

M. H. Bennett

BY Munn & Co.

ATTORNEYS

UNITED STATES PATENT OFFICE.

CHARLES PRESCOTT AND MOSES H. BENNETT, OF FAIRMOUNT, NEBRASKA.

SAND-SCREEN.

SPECIFICATION forming part of Letters Patent No. 447,162, dated February 24, 1891.

Application filed June 30, 1890. Serial No. 357,269. (No model.)

To all whom it may concern:

Be it known that we, CHARLES PRESCOTT and MOSES H. BENNETT, of Fairmount, in the county of Fillmore and State of Nebraska, have invented a new and Improved Sand-Screen, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved sand-screen which is simple and durable in construction, very effective in operation, and quickly separates the fine sand from the coarser materials, such as gravel, &c.

The invention consists in certain parts and details and combinations of the same, as will be described hereinafter, and then pointed out in the claim.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a side elevation of the improvement with parts in section. Fig. 2 is an upper end view of the improvement; and Fig. 3 is a perspective view of part of the screen, showing the fastening of the coiled wire to the longitudinal bars.

The improved sand-screen A is provided with a suitable frame B, having an inclined head C and a foot D, said head and foot being connected with each other by suitable beams E. In the frame B is arranged a screen F, having a longitudinal and slightly-inclined shaft G, carrying at its lower end a crank-arm H for conveniently turning the shaft and its screen. The shaft is mounted near its lower end in a bearing I secured on the foot D, and the upper end of the said shaft is journaled in a bracket J, secured to the head C and projecting through the opening C′ in the latter a suitable distance into the screen F, as is plainly shown in Fig. 1. The bracket J is arranged in this form so as to present no obstruction when introducing material through the opening C′ into the upper end of the screen F.

On the shaft G are secured sets of spokes K, which support at their outer ends longitudinally-extending bars L, each provided with recesses L′ formed on their inner sides and adapted to receive the coils of a wire N forming the meshes of the screen. The wire N is coiled in cylindrical form and is passed into the several recesses L′ of the longitudinal bars L, after which the part L² extending between two successive recesses L′ is hammered so as to cover the coil, thereby holding the latter in place on the longitudinal bars. The coil of wire N extends throughout the length of the bars L and the coils are placed suitable distances apart, according to the material under treatment.

In the bottom of the opening C′ is secured a semicircular plate O, which extends into the upper end of the screen F, so that the material passed over the said plate O is guided onto the upper end of the screen. As the latter is placed in an inclined position, the material readily passes from the upper end of the screen toward its lower end when the shaft G is turned, and the material is constantly agitated by the revolution of the screen, so that the fine sand falls through the meshes formed by the coils of the wire N between the head C and the foot D, while the coarser material travels along the screen to the lower end and drops out of the latter at the outside of the foot D.

It will be seen that a screen formed in this manner is very simple and durable in construction, can be cheaply manufactured, and is not liable to get out of order. The bars L are preferably of a soft metal, so as to permit easy riveting of the parts L² to lock the coils of the wire N in place.

The bars L may be placed inside the coil of wire N, and in this case the recesses L′ are formed on the outer side or top of the bars.

Having thus described our invention, we claim as new, and desire to secure by Letters Patent—

The herein-described screen, comprising the frame B, having a circular opening C′ in its front, a double angle-bracket J, secured to the front of the frame, projecting through the said opening, and having a shaft-bearing in the lower end of its inner depending arm, a bearing I at the opposite end of the frame, a rotary sieve having a central shaft G mounted in the said bearings, the bracket J, projecting into the interior of the screen, as shown, and the curved plate O, projecting inwardly from the bottom of the opening C′, substantially as set forth.

CHARLES PRESCOTT.
MOSES H. BENNETT.

Witnesses:
CLARK ROBINSEN,
J. E. CURTISS.

(No Model.)

J. NORWOOD.

SCREEN FOR SAND, &c.

No. 571,575. Patented Nov. 17, 1896.

Fig. 3.

Fig. 4.

Fig. 2.

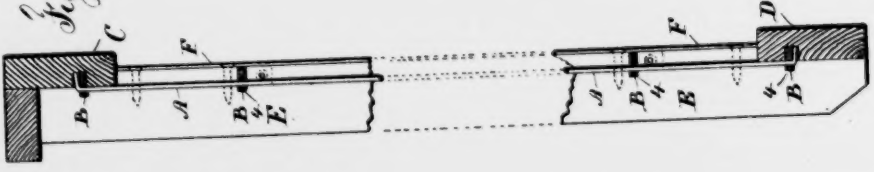
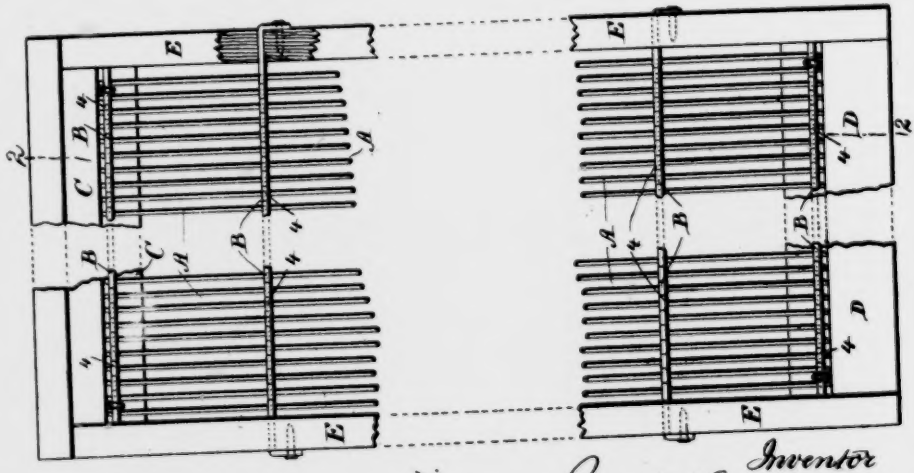


Fig. 1.



Witnesses
Chas. A. Smith
J. Stair

Inventor
Joseph Norwood
per L. W. Serrell & Son
Attys

UNITED STATES PATENT OFFICE.

JOSEPH NORWOOD, OF BROOKLYN, NEW YORK

SCREEN FOR SAND, &c.

SPECIFICATION forming part of Letters Patent No. 571,575, dated November 17, 1896.

Application filed March 11, 1896. Serial No. 582,719. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH NORWOOD, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented an Improvement in Screens for Sand, &c., of which the following is a specification.

Screens have heretofore been made with longitudinal parallel wires and the wires have been kept at the proper distances apart by cross-lacings of wire, and in some instances the lacing-wires have also secured transverse rods. This involves considerable hand labor and the expense is correspondingly increased. In other instances the parallel wires have been let into notches in the edges of bars and the metal at the ends of the notches has been upset or riveted, so as to spread the same partially over the wires and hold them in position; but this mode of securing the wires is unreliable and requires considerable labor in spreading or upsetting the metal to secure the wires.

The object of the present invention is to simplify the construction of the screen, lessen the cost of the same, and render the connection between the wires and the cross-bars stronger and more durable.

I make use of parallel wires held together by one or more cross-bars, each cross-bar being made with diagonal incisions for the reception of the wires, and which wires are held firmly in position by bending down the hook-shaped points of the cross-bars at the acute angles between the slots and the edges of the cross-bars, thus firmly grasping and holding the parallel wires; and in constructing a sand-screen I use similar cross-bars at the top and bottom ends, the same being introduced into grooves or between transverse slats at the top and bottom ends of the screen, and the ends of the cross-bars are bent up at right angles, so as to firmly hold the side pieces of the screen-frame in their proper relative positions.

In the drawings, Figure 1 is an elevation representing the top and bottom portions of a sand-screen, one of the side pieces being in section. Fig. 2 is a longitudinal section at the line 2 2. Fig. 3 shows part of one of the cross-bars with some of the wires in position and with some of the slots open ready for the reception of the longitudinal wires, and Fig. 4 is a plan of the parts shown in Fig. 3.

The parallel bars A or wires are of any desired size, shape, and length, and the cross-bars B are applied at suitable distances apart, and each cross-bar is of the desired strength and preferably of a comparatively soft steel, and in one edge of each cross-bar slots 3 are made by the action of a suitable die and punch or by saws or cutters. Each slot is diagonal, so as to leave the metal at one side of the slot in the form of an acute angle, and the slots are sufficiently deep for the acute angles to form hooks 4, and the wires are introduced into the slots and resting at the bottoms of the slots the hooks 4 are pressed down or bent over the wires, so as to retain them in position in a very firm and reliable manner, and by making the slots in the form represented in Fig. 3 the acute-angle hooks 4 can be bent down rapidly by a roller or other tool forcibly brought into contact with the edge of the bar and passed across the same.

It is advantageous to bend the ends of the wires A at right angles, so as to come outside the top and bottom cross-bars of the screen and thus prevent end motion to such wires.

Screens made in this manner can be made up into any desired form, and where they are employed with a wooden frame, as shown in the drawings, for use in screening sand, ashes, or other materials, the top and bottom cross-bars and the bent ends of the wires A are received into grooves in the top and bottom cross-pieces C and D, which connect the side pieces E at the upper and lower portions of the screen, or these top and bottom cross-bars B may be received between two of the slats or cross-pieces forming the top and bottom ends of the screen.

The intermediate cross-pieces B on the screen are made sufficiently long for their ends to project beyond the side pieces E, and such cross-pieces are received into notches or saw-cuts in the back edges of such side pieces E, and they are bent outwardly and at right angles and preferably secured by screws or nails passing through the perforated ends of the cross-bars, so as to connect the side pieces E firmly to the cross-bars, and I usually employ bands F, nailed or screwed to the back edges of the side pieces E, as an ad-

ditional support for holding the cross-bars B in their proper positions.

I claim as my invention—

1. The combination in a screen with the top and bottom cross-pieces having grooves in their surfaces, of longitudinal parallel wires having their ends bent at right angles, cross-bars each having diagonal slots forming acute-angle hooks, the slots receiving the wires and the hooks bent down to hold such wires in place, the intermediate cross-bars being secured at their ends to the side members of the frame and the cross-bars at the respective ends of the parallel wires being received with the bent ends of such wires into the grooves of the top and bottom cross-pieces of the frame, substantially as set forth.

2. The combination in a screen with the parallel wires, of cross-bars slotted diagonally and receiving the wires, the acute-angled hooks of the cross-bars being bent down to hold the wires in position and the ends of the cross-bars being bent at right angles, the cross-pieces C D and the side frames connected together, such side frames being notched for the passage of the end portions of the cross-bars, and to which side pieces the ends of the cross-bars are connected, substantially as set forth.

Signed by me this 9th day of March, 1896.

JOSEPH NORWOOD.

Witnesses:

GEO. T. PINCKNEY,

MARY L. BYRNE.

238

(No Model.)

J. B. JOHNSTON.

FENCE POST.

No. 589,898. Patented Sept. 14, 1897.

Fig. 1.

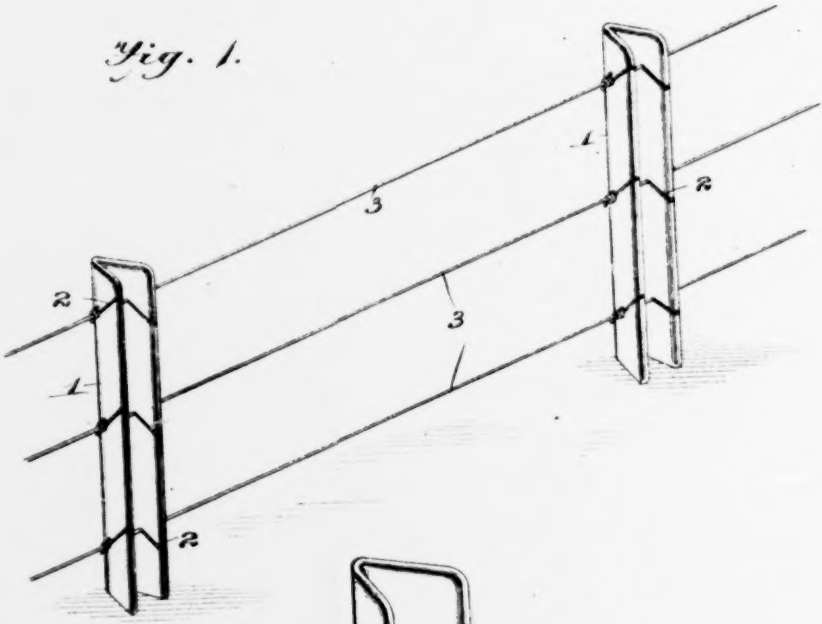
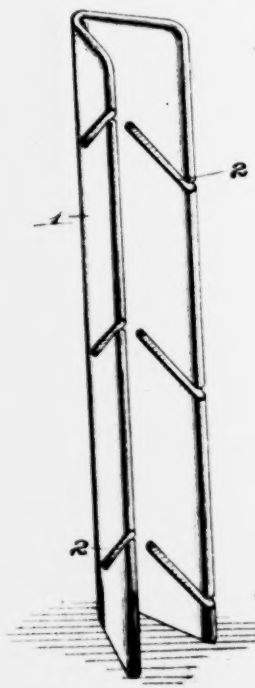


Fig. 2



WITNESSES

C. E. Hunt.

A. M. Poynton

INVENTOR

James B. Johnston,

By John Huddersburn

Attorney

UNITED STATES PATENT OFFICE.

JAMES BOWER JOHNSTON, OF PUEBLO, COLORADO, ASSIGNOR OF ONE-HALF TO H. W. GIBBONS AND CHARLES H. SCHELL, OF SAME PLACE.

FENCE-POST.

SPECIFICATION forming part of Letters Patent No. 589,898, dated September 14, 1897.

Application filed January 12, 1897. Serial No. 618,920. (No model.)

To all whom it may concern:

Be it known that I, JAMES BOWER JOHNSTON, a citizen of the United States, residing at Pueblo, in the county of Pueblo and State of Colorado, have invented certain new and useful Improvements in Fence-Posts; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In a companion application filed January 12, 1897, Serial No. 618,919, I have described an improved form of fence-post which is V-shaped in cross-section and is provided with oppositely-disposed angularly-arranged slits in the outer edges of the sides thereof, through which the line-wires are adapted to be passed, and a woven-wire clamping device for preventing the lateral displacement of the line-wires. The said fastening device has proved very effective, but in order that a more permanent means of securing the line-wires in place may be provided I have devised another form of fence-post, which forms the subject-matter of the present application.

This invention therefore consists of a fence-post constructed of any suitable form and dimensions and of concrete or other analogous material, the side edges thereof being provided with slits through which the line-wires of the fence pass, the said line-wires being securely held in place by means of cement, concrete, or other like material applied to said slits and closing them after the line-wires are in place.

The invention is clearly illustrated in the accompanying drawings, in which—

Figure 1 represents a perspective view of a fence, showing my improved fence-post and the line-wires connected thereto. Fig. 2 is a detail perspective view of one of the posts before the line-wires are applied.

Like reference-numerals indicate like parts in both views.

As above stated, the fence-post 1 may be of any suitable form and dimensions. The same is preferably constructed of concrete, fire-clay, or other analogous material, and has cut in the side edges thereof angularly-arranged slits 2 2, through which the line-wires 3 are adapted to be passed. When said line-wires have been stretched to the proper degree of tension, they are passed through the slits, and are afterward secured in place by means of cement or concrete, which is placed around said wires on the inside of said slits, closing the latter and making a homogeneous post.

While I have referred herein to the line-wires 3 as passing through the slits 2 2 in said fence-post, it is obvious that I may employ, instead of said line-wires, bands, chains, gas-pipe, or any other suitable fencing material, the method and application being the same whatever material may be used.

Having now described the invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A fence-post having slits in the side edges thereof through which the line-wires are adapted to be passed, the said line-wires being held in place by the application of cement or concrete to said slits, substantially as described.

2. A fence-post having angularly-arranged slits in the outer edge thereof in which the line-wires of the fence are adapted to be inserted, the said line-wires being sealed in place and prevented from slipping by means of cement or concrete applied in a plastic condition to said slits, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JAMES BOWER JOHNSTON.

Witnesses:
JOHN S. HAMMOND,
H. W. ROBERTS.

240

No. 657,827. Patented Sept. 11, 1900.

W. McCALL.

METAL LATH ATTACHMENT AND SUPPORT.

(Application filed May 2, 1900.)

No Model.)

Fig. 1.

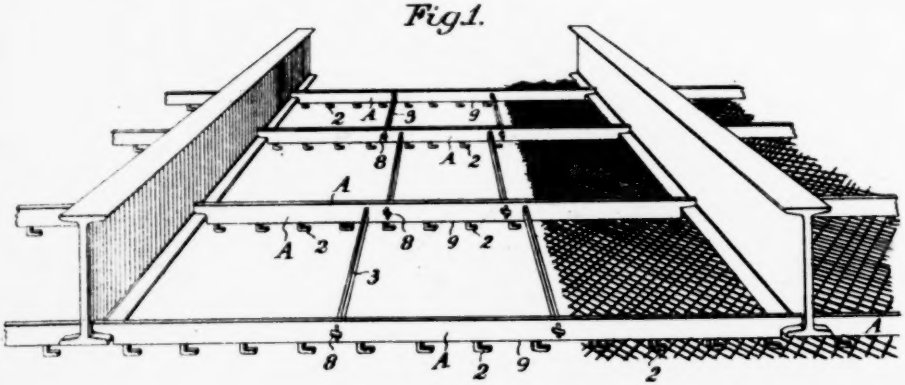


Fig. 2

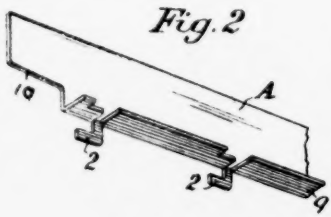


Fig. 3.

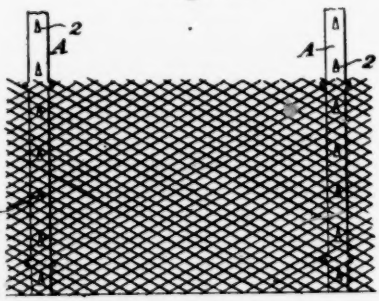


Fig. 4.

Fig. 5.

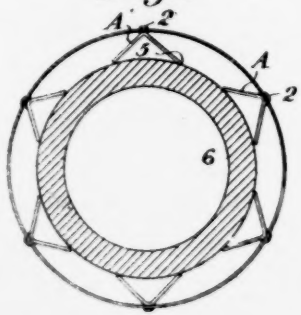


Fig. 8.

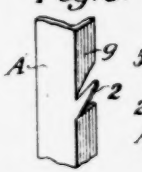


Fig. 6.

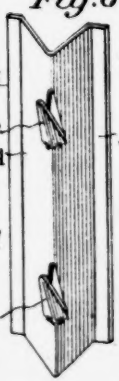


Fig. 7.

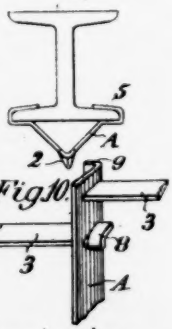


Fig. 9.

Fig. 10.

Witnesses,
E. A. Brandau
J. L. Amse

Inventor,
William McCall
By Dewey Stong & Co. Attys

UNITED STATES PATENT OFFICE.

WILLIAM McCALL, OF SAN FRANCISCO, CALIFORNIA.

METAL-LATH ATTACHMENT AND SUPPORT.

SPECIFICATION forming part of Letters Patent No. 657,827, dated September 11, 1900.

Application filed May 2, 1900. Serial No. 15,206. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM McCALL, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented an Improvement in Metal-Lath Attachments and Supports; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to a means for securing and supporting metal lathing, such as is employed in the construction of fireproof and other buildings.

It consists of the parts and the constructions and combination of parts hereinafter described and claimed.

Figure 1 is a perspective view showing the application of my invention as applied to a ceiling. Fig. 2 is a view of the metal-lath attachment. Fig. 3 is a view showing application to a wall. Fig. 4 is a plan. Fig. 5 shows the application to a column. Fig. 6 is a view of a modification. Fig. 7 shows application to ceiling-beam. Fig. 8 shows a modification of the hooks. Figs. 9 and 10 are detail views of the transverse strips.

The objects of my invention are to provide a means for rapidly attaching the sections of wire or expanded metal laths to the partitions, ceiling, or other portions where the lath and plastered surfaces are to be applied and to form a plurality of supports and attachments, so that the lathing is firmly held in place and is prevented from sagging or pulling away from the support when the plaster is applied or under other conditions.

I have here illustrated my invention as applied in various ways to structures where it is desirable to apply lathing.

A represents the support to which the lath is to be applied, which may be a vertical or horizontal partition or ceiling surface, or an intermediate plate attached to brick or other walls, or to columns to form a support for the lathing.

The lath-supporting structure A may be formed of parallel vertical or horizontal strips, upon the edges of which the tongues 2 are formed, and these strips are united to form a rigid structure by intermediate transverse strips or bars 3, which have tongues 8 at the ends, formed by slitting the ends transversely. These tongues pass through corresponding slots or openings in the strips A and may afterward be folded, twisted, or otherwise locked firmly to them. The edges of the strips A may be bent at right angles to form flanges 9 between the hooks, thus stiffening the strips when made of light or thin metal.

In order to support the strips A when used for ceiling purposes, the ends are cut away, as shown at 10, to correspond in shape with the lower flanges of the I-beams of the floor above, over which these ends extend toward the vertical web. The strips thus present a vertical depth sufficient to prevent sagging and are stiffened horizontally by the flanges 9 as well as by the intermediate connecting strips or bars 3. It will be understood that the same construction used as a vertical partition would have its upper and lower ends properly secured to the ceiling-beams and floor. The tongues or spurs 2 then project from the lower surface of these strips A and are in position to receive the lathing.

If the lathing is to be attached to a brick or other wall where it is desirable to have an air-space between the wall and the plastered surface, the strips A are bent into a curved or V shape or other desired form having flanges, as shown at 5, which flanges are perforated, so that nails can be driven through the holes and into the mortar-spaces between the brick or other material of which the wall is formed. The strips A are thus secured to the wall, and the outer curve or angle is then slit, as shown, so as to form the projecting tongues 2, which are bent outwardly to receive the laths.

If a column, such as is shown at 6, is to have a plastered surface, the strips A may be made either V-shaped or slightly curved and of a length sufficient to extend vertically up and down the column which is to be covered, and they may be secured in place with their open bases against the column, the angular portion presented outwardly, and the tongues 2 are cut out from these angular portions, as before described. The strips A in this case are secured to the column by wires around them at intervals or by other suitable means.

The lathing, which, as before stated, may be of wire, expanded metal, or sheets of any description having interstices through which the mortar will pass to form a bond, are then rapidly hooked upon the projecting tongues

2, which pass through the slots or interstices in the lathing, and thus support them at many points. After the lathing has thus been hung upon the points the latter are bent or closed down, so as to lock the lathing in place, by a tap of a hammer or other means, and the whole is firmly secured and supported ready to receive the plaster.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with parallel strips having slots, of transverse strips having their ends passed through said slots and transversely slitted to form tongues adapted to be bent to lock the transverse strip to the parallel strips.

2. A support for metallic lathing consisting of metallic plates, means for securing said plates to the wall, partition or ceiling to be covered, transverse connections having ends passed through the plates and locked thereto by twisting or bending, and tongues formed by slits made in the part to which the lath is to be attached, said tongues having the base connected with the support, and the point projecting outwardly therefrom.

3. The combination with a supporting-base of plates or strips of sheet metal having slits cut upon the sides to form tongues with one end remaining attached to the strip, said strips extending over the lower flanges of the I-beams, and having one or both edges turned at right angles with the vertical depth of the strips, and transverse connections having ends passed through the strips and locked thereto.

4. Supports for metallic lathing consisting of parallel strips of metal having slits cut to form projecting tongues upon the edges, transverse strips or bars having the ends formed to pass through corresponding slots in the adjacent parallel strips and adapted to be locked thereto by twisting or bending.

In witness whereof I have hereunto set my hand.

WILLIAM McCALL.

Witnesses:
S. H. NOURSE,
JESSIE C. BRODIE.

No. 682,316. Patented Sept. 10, 1901.

W. L. CALDWELL.

STUD FOR BUILDING CONSTRUCTION.

(Application filed Sept. 15, 1900.)

(No Model.)

Fig. 1. Fig. 2. Fig. 3.

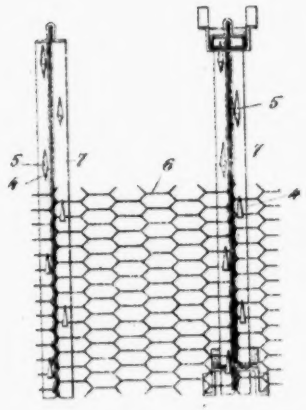
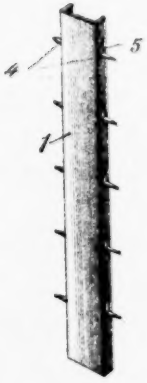


Fig. 4. Fig. 5. Fig. 6.



WITNESSES:

M. A. Scherer

H. C. Hammond.

INVENTOR

William L. Caldwell

BY

ATTORNEYS.

UNITED STATES PATENT OFFICE.

WILLIAM L. CALDWELL, OF NEW YORK, N. Y., ASSIGNOR OF TWO-THIRDS TO JOHN W. RAPP AND HENRY LOY EASTON, OF SAME PLACE.

STUD FOR BUILDING CONSTRUCTION.

SPECIFICATION forming part of Letters Patent No. 682,316, dated September 10, 1901.

Application filed September 15, 1900. Serial No. 30,120. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM L. CALDWELL, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Studs for Building Construction, of which the following is a specification.

This invention relates to improvements in studs for building construction adapted for use with perforate sheets or open-work metal lathing, particularly the expanded metal or similar lathing now in use for fireproof construction.

The invention consists in a stud or strip of rolled metal or other suitable malleable material with projections formed thereon and therefrom by punching through the metal of the stud, leaving the punched portion attached along one edge or end and with metal on both sides thereof and bending it out to form a projection, tongue, or prong capable of passing through a perforation in the metal lathing and engaging with the lathing to support same and adapted to be bent back or over the lathing, so as to hook or clench same firmly in place.

In the accompanying drawings, Figure 1 is a perspective view of a stud provided with my invention. Fig. 2 shows the studs with a portion of metal lathing in place thereon, the view being taken in front, but looking down at an angle in the structure. Fig. 3 is a vertical section of the stud and lathing from front to back. Figs. 4 to 6 show the application of the invention to various forms of stud or strip.

Referring to Fig. 1, a stud of rolled malleable metal is represented at 1, with flat face portions 2, connected by a doubled or folded central portion 2', this latter portion being preferably not bent into close contact, but kept somewhat open at the bend 3, so as not to crack the metal by too sharp bending. The flat face portion of metal stud 1 is punched or slit at a number of places, forming a plurality of prongs or tongues 4, which are allowed to adhere to the stock at one edge or end. These prongs are bent out either at the time of punching or afterward to form projections and leaving holes 5 in the stud with metal on both sides of the hole or of the prong, so that the stud is not materially weakened. The prongs may be punched up from any portion of the stud—that is, sufficiently removed from the edge and sufficiently thin—but they are preferably punched from a flat portion of the stud.

The studs having been set up in position, the metallic perforate lathing is attached thereto, as shown in Figs. 2 and 3, the said lathing (represented at 6) being placed against the studs 7 and the prongs 4 passing through the perforations in the lathing and engaging with the ribs thereof to support the same. The tongues or prongs 4 being malleable may then be upset or bent over or backward, so as to clench the lathing to the post.

Fig. 4 shows a furring-strip for side walls or ceilings, Fig. 5 an angle-stud, and Fig. 6 a box-stud, all provided with prongs 4 for engaging and supporting the metallic lathing. In the form of my invention shown in Fig. 4 the groove portion or longitudinal loop portion of the furring-strip is the part that is provided with projecting tongues or tangs 4 and the sides of the loop, which are separated, as shown, terminate in lateral flanges.

Studs may be shipped with the prongs unbent, so as to prevent injury; but by properly stacking the studs in shipment they may be safely shipped with the prongs bent out, and for convenience it is preferable to furnish them in this condition.

What I claim as new, and desire to secure by Letters Patent, is—

1. A building construction comprising perforate metallic lathing and a stud of malleable metal with flat prongs formed thereon and therefrom by making perforations in the flat portion of the metal strip so that the prongs are supported at one end and have metal on each side of them projecting through perforations in the lathing and bent over the latter so as to clench same.

2. A stud for partitions comprising a longitudinal loop portion, the edges of which are separate, lateral flanges at said edges and tangs formed from the metal comprised in the loop portion.

3. A stud for partitions comprising a longitudinal loop portion, the edges of which are separate one from the other, lateral flanges provided at said edges, and means in the said loop portion by which wire or other lath may be secured to said loop portion.

4. A stud for partitions comprising a longitudinal loop portion and means provided therein by which wire or other lath may be secured thereto.

WILLIAM L. CALDWELL

Witnesses:
A. P. KNIGHT,
J. GREEN.

Correction in Letters Patent No. 682,316.

It is hereby certified that in Letters Patent No. 682,316, granted September 10, 1901, upon the application of William L. Caldwell, of New York, N. Y., for an improvement in "Studs for Building Construction," an error appears in the printed specification requiring correction as follows: Page 1, line 93, claim 1, before the word "projecting" insert a comma; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of January, A. D., 1916.

[SEAL.]

R. F. WHITEHEAD,

Acting Commissioner of Patents.

Cl. 189–9

No. 723,657. PATENTED MAR. 24, 1903.

S. L. EASON.

FENCE POST.

APPLICATION FILED SEPT. 12, 1902.

NO MODEL.

Fig. 1.

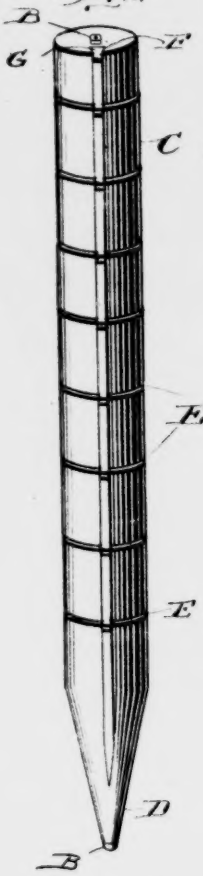


Fig. 2.

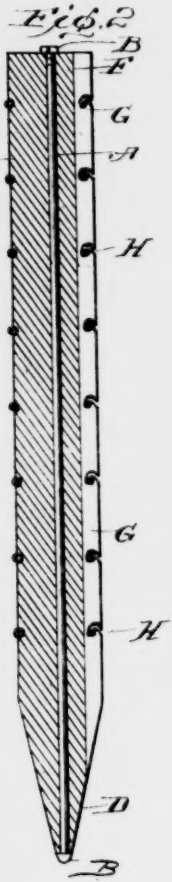


Fig. 4.

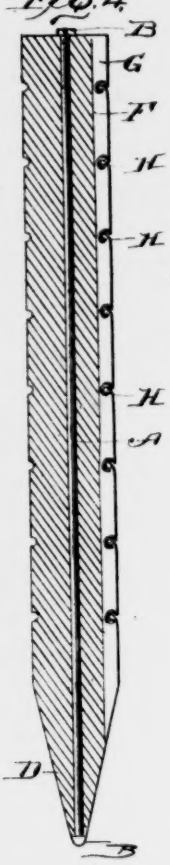


Fig. 3.

Inventor
Samuel L. Eason

Witnesses
J. M. Fowler Jr.
Mary E. Moore

Wm. N. Moore
Attorney

UNITED STATES PATENT OFFICE.

SAMUEL L. EASON, OF SCRANTON, IOWA, ASSIGNOR OF ONE-HALF TO SILAS G. KIONS, OF SCRANTON, IOWA.

FENCE-POST.

SPECIFICATION forming part of Letters Patent No. 723,657, dated March 24, 1903.

Application filed September 12, 1902. Serial No. 123,083. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL L. EASON, a citizen of the United States, residing at Scranton, in the county of Greene and State of Iowa, have invented certain new and useful Improvements in Fence-Posts, of which the following is a specification.

My invention relates to improvements in fence-posts; and the object of my invention is the production of a fence-post which will be indestructible, attractive in appearance, thoroughly efficient, and inexpensive of production, thus insuring a practical fence-post.

With this object in view my invention consists of a fence-post embodying novel features of construction and combination of parts, substantially as disclosed herein.

Figure 1 represents a perspective view of my fence-post. Fig. 2 represents a vertical sectional view with the wires shown in the strip and post. Fig. 3 represents a horizontal sectional view, and Fig. 4 represents a vertical sectional view.

A designates a vertical rod which forms the core or center of my fence-post, said bar having threaded ends to receive nuts B, which serve to sustain the body C of the fence-post, said body being of cylindrical shape with the lower tapering end D to facilitate insertion or driving of the post into the ground. The body of the post is preferably made of cement and is formed with a series of grooves or depressions E, the purpose of which is to receive wires for binding the horizontal line-wires of the fence, and the body is formed on one side with an angular vertical channel F, which receives the strip G, which may be made of wood and to which the horizontal line-wires are secured by means of staples, as will be apparent, or the vertical strip may be made of metal and formed with a series of kerfs or seats H, which receive and hold the line-wires in place.

From the foregoing description and drawings it is evident that I provide a fence-post which is inexpensive of production and very durable and which is thoroughly efficient and practical.

I claim—

The fence-post herein shown and described, consisting of the central rod or core having a nut on its upper end and a tapering head on its lower end to enable the post to be easily driven, a plastic body surrounding the rod and having a vertical channel in one side, a series of parallel transverse grooves around the body and a tapering lower end and a strip fitting in the channel of the body having kerfs to receive the line-wires.

In testimony whereof I affix my signature in presence of two witnesses.

SAMUEL L. EASON.

Witnesses:
ALLEN GLENN,
P. P. PITCHER.

248

No. 736,602. PATENTED AUG. 18, 1903.

J. KAHN.

CONCRETE AND METAL CONSTRUCTION.

APPLICATION FILED DEC. 11, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

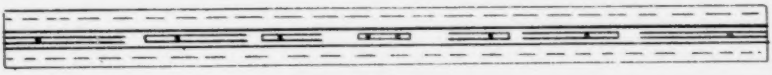


Fig 1

Fig 2

Fig 3

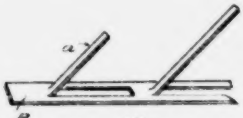


Fig 4

Fig 5

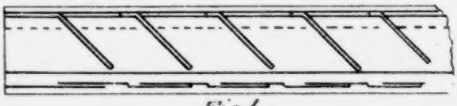


Fig 6

Fig 8

Fig 7

Fig 9

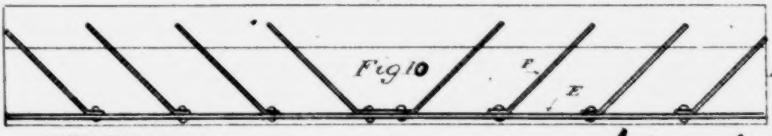


Fig 10

Fig 11

WITNESSES.

W. V. Robertson

M. B. Dougherty

INVENTOR.

Julius Kahn

By Thos. G. Dragoo & Son

Attorneys.

No. 736,602. PATENTED AUG. 18, 1903.

J. KAHN.

CONCRETE AND METAL CONSTRUCTION.

APPLICATION FILED DEC. 11, 1902.

NO MODEL. 4 SHEETS—SHEET 2.

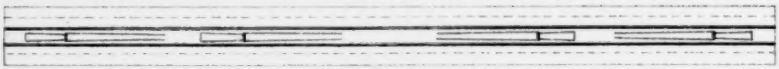


Fig. 12

Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig. 17

Fig. 18

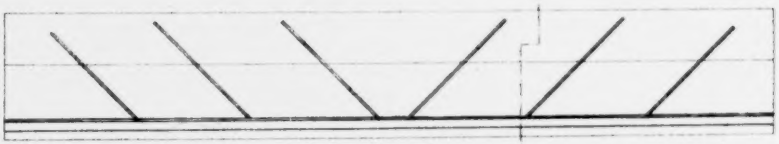


Fig. 19

Fig. 20

Fig. 21

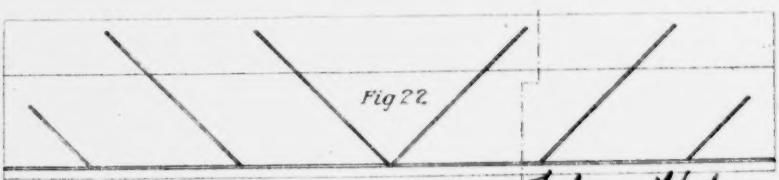


Fig. 22

Fig. 23

Witnesses:
C. S. Roberson.
W. B. Dodge Jr.

Julius Kahn
Inventor:
By Dodge & Sheppard
Attys.

250

No. 736,602. PATENTED AUG. 18, 1903.

J. KAHN.

CONCRETE AND METAL CONSTRUCTION.

APPLICATION FILED DEC. 11, 1902.

NO MODEL. 4 SHEETS—SHEET 3.

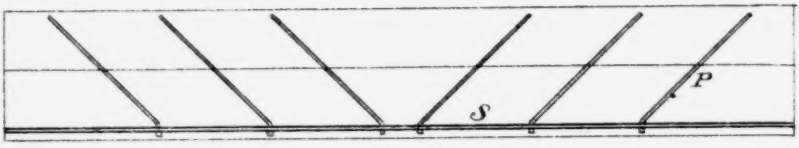


Fig. 24

Fig. 25

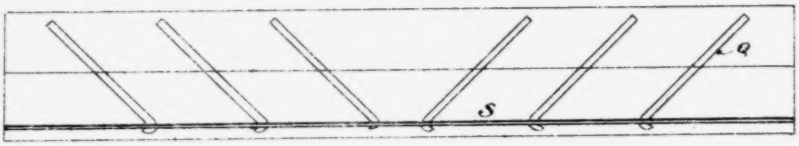


Fig. 26

Fig. 27

Fig. 28

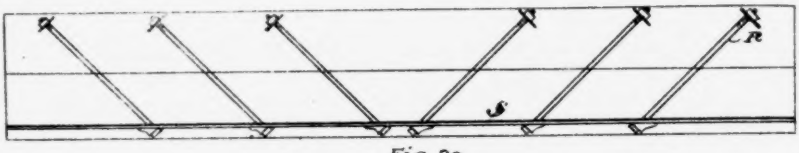


Fig. 29

Fig. 30

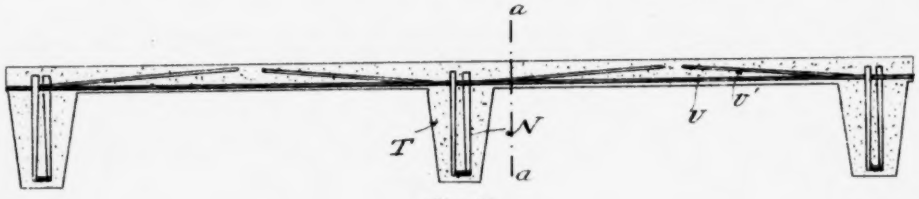


Fig. 31

Fig. 32 Section a-a

Witnesses:
A. G. Robertson.
Geo. L. Peterson

Julius Kahn
Inventor:
Wood, Thacher & Thacher
Attys.

251

No. 736,602. PATENTED AUG. 18, 1903

J. KAHN.

CONCRETE AND METAL CONSTRUCTION.

APPLICATION FILED DEC. 11, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

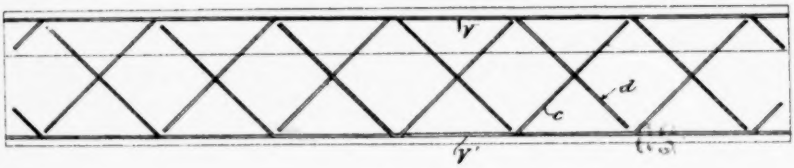


Fig. 33

Fig. 34

Fig. 35

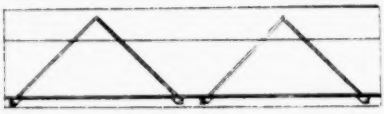


Fig. 36

Fig. 37

Fig. 38

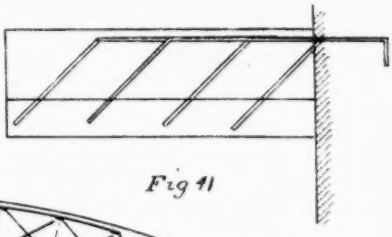


Fig. 41

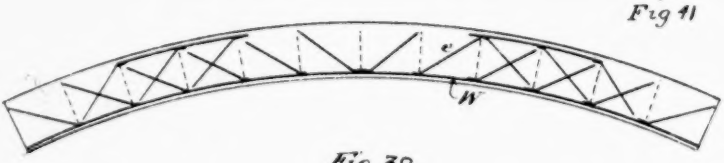


Fig. 39

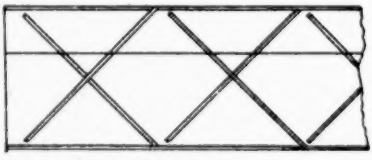


Fig. 42

Fig. 43

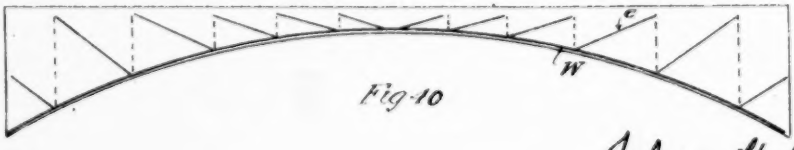


Fig. 40

Witnesses:
G. G. Robertson
Thos. D. Lafferty

Julius Kahn
Inventor
By Thos. D. Lafferty
Atty's

UNITED STATES PATENT OFFICE.

JULIUS KAHN, OF DETROIT, MICHIGAN.

CONCRETE AND METAL CONSTRUCTION.

SPECIFICATION forming part of Letters Patent No. 736,602, dated August 18, 1903.

Application filed December 11, 1902. Serial No. 134,804. (No model.)

To all whom it may concern:

Be it known that I, JULIUS KAHN, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Composite Concrete and Metal Constructions, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to composite concrete and metal constructions, and has for the primary object the obtaining of a trussed construction in which a portion of the trussed members are formed by metal and the remaining portion by concrete or cement.

It is a further object to so construct and arrange the metallic members within the body of cement that a plurality of minor members are rigidly secured at one end to a main member, whereby the stresses developed within the former are directly carried into the latter.

The invention consists in the peculiar construction of metallic members and their arrangement in relation to the body of the cement, and, further, in the construction in which the minor and main metallic members are formed from an integral blank or structural shape, and, further, in a peculiar construction and arrangement and combination of parts, as more fully hereinafter described in claims.

In the drawings I have illustrated diagrammatically various modifications of my invention, the metallic members being shown in elevation and the outline of the body being also indicated in full lines.

Figures 1, 2, and 3 are respectively a plan, side elevation, and cross-section of the beam employing my invention. Fig. 4 is a perspective view of a metallic strengthening member employed. Fig. 5 shows the inclined bars sloping opposite from those in Fig. 2. Figs. 6, 7, 10, 13, 15, 17, 19, 22, 24, 26, 29, 33, 35, 36, and 38 are elevations similar to Fig. 2, illustrating various modifications. Figs. 9, 11, 14, 16, 18, 20, 23, 25, 27, 30, 34, and 37 are cross-sections similar to Fig. 3 respectively through adjacent elevations. Figs. 8 and 28 are perspective views of modified constructions of metallic members. Fig. 12 is a plan view of the adjacent elevation 13, and Fig. 21 is a plan of the struck-up bar in Fig. 22. Figs. 31 and 32 illustrate a floor construction embodying my invention; Figs. 39 and 40, arches. Fig. 41 is an elevation showing an overhanging ledge. Fig. 42 is an elevation showing a construction in which the longitudinal members are not embedded in the cement body, but lie adjacent thereto; and Fig. 43 is a cross-section thereof.

A common feature of all the various modifications above referred to is that a main metallic member is connected to a plurality of supplemental metallic members and the latter being attached to one end to the main member and extending obliquely therefrom into the cementitious body. Furthermore, in all of the arrangements shown the main members correspond to the chords of a truss and the minor members to the web. The intention of the invention is to so place the metal within the concrete that each is stressed in the manner most advantageous to its special nature.

In Figs. 1 to 4 the metal is arranged to correspond to the tension members in the ordinary Pratt truss. A designates the body, of concrete or other cementitious rectangular form and is adapted for use as a beam. B is the metallic strengthening member, which is formed of a flat bar of metal having a plurality of portions *a* thereof struck up centrally from the bar into an inclined position. As shown in Fig. 4, these inclined portions *a* are preferably of varying size, the end members a' being of the greatest length and the middle members a^2 being the shortest. The main member B is arranged adjacent to the lower edge of the body, but slightly embedded therein, and the minor members *a* incline upward oppositely upon opposite sides of the center of the beam. The effect of this arrangement in the completed beam is that the tensile stresses developed in the minor members *a* are communicated to the main member B directly, while the compression stresses intermediate said members *a* are resisted by the concrete through the lines shown dotted. Where main metallic members are entirely distinct from each other, (see Fig. 33,) they are in the same manner held together through the concrete which grips the projecting web

members. In Fig. 33 is shown how a metallic truss is thus completed, the concrete performing the same function as the web in a plate or latticed girder. With this arrangement it is not even necessary that the main members lie within the concrete at all, as their strain depends largely on the pull brought into them by the inclined members.

In Fig. 5 the main bar B is substantially the same as in Fig. 2, with the exception that web-bars incline in the opposite direction.

In Figs. 6, 7, 8, and 9 is shown a construction which may be used as a column in which the metallic strengthening members are arranged adjacent to each of the sides of the body. Each of these metallic members is formed from a flat bar having portions *b* struck up therefrom, but from the side of the bar instead of the center-portion thereof.

In Figs. 10 and 11 metallic members are employed in which the main member E has riveted thereto the inclined auxiliary members F.

Figs. 12, 13, and 14 illustrate a construction in which an I-beam G has portion H of the web thereof struck up to form the inclined auxiliary members.

In Figs. 15, 16, 17, 18, 19, and 20 are respectively arranged the channel-beam J, a pair of angle-beams K, and a T-beam L, each of which have portions M struck up from the webs thereof to form the inclined auxiliary members.

In Fig. 21 there is shown a strengthening member formed from a flat bar N with the auxiliary members O and O′ alternately struck up from the opposite sides of the bar.

In Figs. 24, 25, 26, 27, 28, 29, and 30 the auxiliary members P, Q, and R have a hooked or headed engagement with the main members S.

Figs. 31 and 32 show a monolithic floor and beam construction in which the beams or girders T are strenghtened by the metallic members N, while the floor slabs are strengthened by cord members U and inclined auxiliary members U′, attached thereto at opposite ends and inclined upwardly.

In Figs. 33 and 34 two main metallic members V and V′ are arranged, respectively, adjacent to the lower and upper edges of the body. These members have auxiliary members *c* and *d* struck up therefrom but oppositely inclined, so as to form, in effect, a lattice-web within the body.

Although only several arrangements of webbed bars are shown here, it is understood that I may wish to use other methods of cutting the web-bars and bolting or riveting the same to the main members, holding, however, to the essential part of the claims, that the web members be secured to the main members, thereby forming the part truss, which is completed in its functions by the property of the concrete.

Figs. 35 to 38 show improved constructions in which the auxiliary members are secured at their opposite ends to the main member.

In Figs. 39 and 40 the main member W is arched to form a compression member, and the auxiliary members *e* extend from said inner member in the cementitious body at various angles.

From the description and illustration given it will be understood that the underlying idea in my invention consists, essentially, in providing a main metallic strengthening member with a plurality of auxiliary members, said auxiliary members being rigidly attached to the main member, so as to transmit the stresses developed therein cumulatively into said main member.

What I claim as my invention is—

1. The combination with a cementitious body of a metallic strengthening member therefor, extending longitudinally thereof, and a plurality of uprightly-extending members, rigidly attached to said longitudinal metallic member, at points intermediate the ends of the latter and projecting obliquely therefrom to form the diagonal members only of a part of a truss, said laterally-extending members being embedded in said cementitious body whereby the stresses are communicated from said latter longitudinally into said main member.

2. The combination with a cementitious body of a metallic member comprising a longitudinally-extending bar and a plurality of laterally-inclined arms, struck up from said metallic member and forming a portion of a truss of which the remaining constituents are formed by the cementitious body.

3. The combination with a cementitious body of metallic members extending longitudinally and on opposite sides of said body; said main metallic members being provided with inclined laterally-extending arms or auxiliary members rigidly secured thereto intermediate their ends and adapted when set in a cementitious body to form substantially a latticed column, main members being united only through the adhesion of the cement.

4. A combination with a cementitious body of a plurality of metallic members arranged to extend longitudinally adjacent to opposite sides of the body, each member being provided with obliquely-extending arms or auxiliary members corresponding to the diagonal members only of a truss, and rigidly secured thereto intermediate its ends, the auxiliary members on the two main members being oppositely inclined to cross each other and depending upon the adhesion of the cementitious body to unite them and to form substantially a latticed girder.

5. The combination with a cementitious body of a plurality of metallic members arranged to extend longitudinally adjacent to opposite sides of said body, each member being provided with obliquely-extending arms or auxiliary members struck up from the same and intermediate its ends, the auxiliary members and the two main members being oppositely inclined to cross each other, and

depending on the adhesion of the cementitious body to both to unite them, and to form substantially a latticed girder.

6. The combination with a cementitious body of a metallic strengthening member therefor, comprising a longitudinally-extending main portion and an obliquely-inclined auxiliary portion struck up from said main portion intermediate its ends, and extending into the cementitious body for the purpose of transmitting stresses thereto.

7. The combination with a cementitious body of a metallic strengthening-body therefor, comprising a longitudinally-extending member of structural shape having intermediate portions thereof struck up to form a portion of a truss of which the remaining constituents are formed by the cementitious body.

In testimony whereof I affix my signature in presence of two witnesses.

JULIUS KAHN.

Witnesses:
M. B. O'DOGHERTY,
A. G. ROBERTSON.

255

No. 752,523. PATENTED FEB. 16, 1904.

A. G. CONSIDERE.

ARMED OR STIFFENED CONCRETE CONSTRUCTION.

APPLICATION FILED JUNE 27, 1902.

NO MODEL.

Fig. 1.

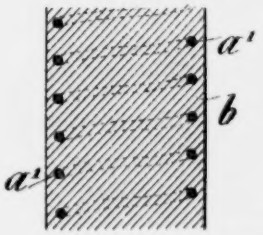


Fig. 3.

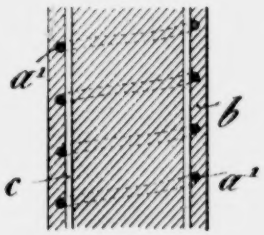


Fig. 2.

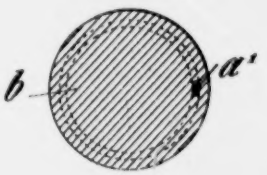


Fig. 4.

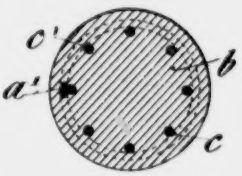


Fig. 5.

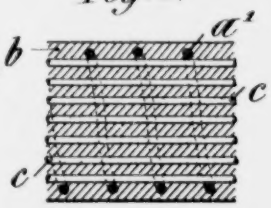


Fig. 6.

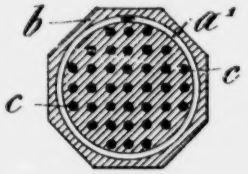
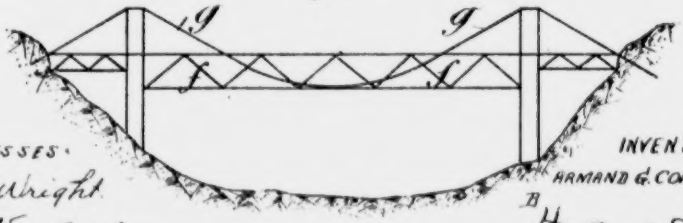


Fig. 7.



WITNESSES:
P. W. Wright
Walter Abbe

INVENTOR
ARMAND G. CONSIDERE
By
Howson and Howson
HIS ATTORNEYS.

No. 752,523. Patented February 16, 1904.

UNITED STATES PATENT OFFICE.

ARMAND GABRIEL CONSIDERE, OF PARIS, FRANCE.

ARMED OR STIFFENED CONCRETE CONSTRUCTION.

SPECIFICATION forming part of Letters Patent No. 752,523, dated February 16, 1904.

Application filed June 27, 1902. Serial No. 113,467. (No model.)

To all whom it may concern:

Be it known that I, ARMAND GABRIEL CONSIDERE, a citizen of the Republic of France, residing in Paris, France, have invented certain new and useful Improvements in Armed or Stiffened Concrete Constructions, of which the following is a specification.

This invention has for its object to produce concrete or cement columns or the like structures which in service are adapted to withstand great compression or tension strains in a longitudinal direction. This object is secured by embedding strengthening-wires in helicoidal coils around a solid concrete core and covering the coils to protect them from the atmosphere.

In the accompanying drawings, Figure 1 is a longitudinal section of part of a column constructed to sustain longitudinal pressure. Fig. 2 is a cross-section of the same. Fig. 3 is a view similar to Fig. 1 of a modification with longitudinal strengthening-rods. Fig. 4 is a cross-section of the same. Fig. 5 is a longitudinal section, and Fig. 6 is a cross-section of a column with a greater number of longitudinal rods and which is to sustain longitudinal tension. Fig. 7 is a side view showing a means for tensioning the longitudinal rods before applying the concrete.

As shown in Figs. 1, 3, and 5, a helicoidal coil of metal *a'* is embedded in a solid core *b* of concrete or cement, so as to embrace the greater part of the solid core, but sufficiently below the surface to be protected from the atmosphere by the outer covering.

In Figs. 3, 4, 5, and 6 besides the helicoidal coils the core is provided with a number of longitudinal metal rods *c*. The object of thus encircling the solid core with the helicoidal coils *a'* of metal is to overcome the tendency of the concrete column when placed under compression strain longitudinally from breaking by lateral expansion of the column later. These helicoidal coils thus greatly increase the strength of a concrete column. It also has been found that when such column has been collapsed by excessive pressure under test warning is given for quite a time before rupture.

Tensional strains in my improved columns or cables are met by providing within the coils *a'* many longitudinal rods *c*, as shown particularly in Figs. 5 and 6.

In Fig. 7 I have represented a practical construction for carrying into effect a method of giving a preliminary tension to the longitudinal wires *c*. They are suspended like an ordinary cable, and I hang a foot-bridge or other temporary structure on them to cause them to take up the curve or other shape that the resulting bridge may require, and I then apply the helicoidal coils and concrete to these cables. By this means rupture of the concrete when the finished tension members are put under tension in use will be avoided.

I am aware that it has previously been proposed to embed in concrete pipes rings of metal; but these structures are hollow and for that reason are not adapted to stand compression or tension strains in a longitudinal direction to which my solid columns or cables are to be subjected.

I am aware of British Patents No. 1,715 of 1874 and No. 14,559 of 1885, showing skeletons of iron made with spiral coils riveted to each other or to longitudinal rods to carry concrete; but in my beams the concrete forms the essential basis of the column and my coils are independent—that is, not connected to the other coils or to longitudinal rods in the concrete.

I claim as my invention—

1. A column or the like of concrete, comprising a solid concrete core with independent helicoidal coils of metal surrounding said core, and arranged very close together, substantially as described.

2. A column or the like of concrete, comprising a solid concrete core with independent helicoidal coils of metal surrounding said core, and arranged very close together, and a covering for the coils, substantially as described.

3. A column or the like of concrete, comprising a solid concrete core, longitudinal rods within the core and independent helicoidal coils of metal arranged very close together and surrounding the core and rods, substantially as described.

4. A column or the like of concrete, comprising a solid concrete core, longitudinal rods

within the core and independent helicoidal coils of metal arranged very close together and surrounding the core and rods, and a covering for the coils, substantially as described.

5. A concrete construction, comprising longitudinal metal rods tensioned in the shape they are to maintain, and a concrete covering for said rods to make a solid core, and independent helicoidal coils arranged very close together, surrounded and retaining the core, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ARMAND GABRIEL CONSIDERE.

Witnesses:

LÉON FRANCKEN,

EDWARD P. MACLEAN.

258

No. 764,883. PATENTED JULY 12, 1904.

R. A. CUMMINGS.

METAL AND CONCRETE COLUMN.

APPLICATION FILED MAR. 4, 1903.

NO MODEL.

Fig. 1

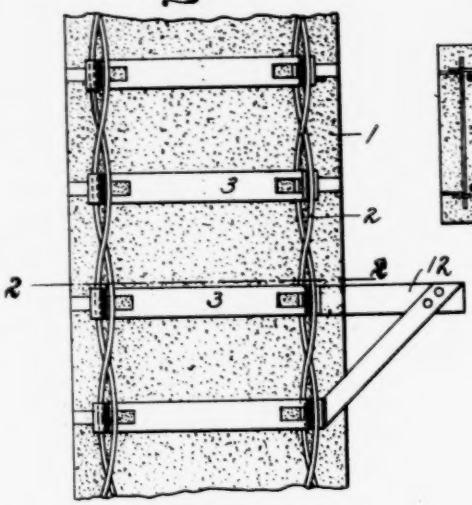


Fig. 5

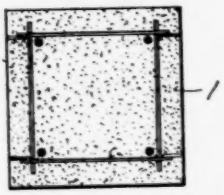


Fig. 6

Fig. 7

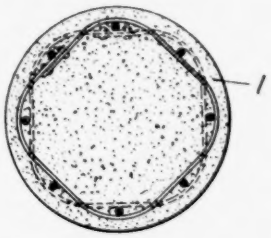


Fig. 2

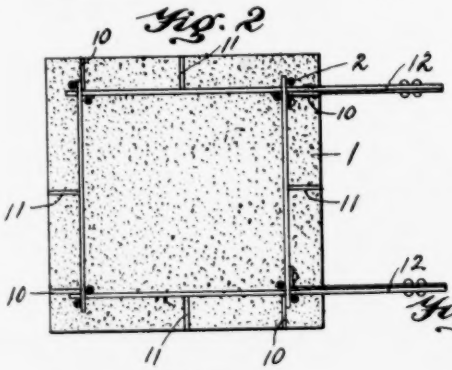


Fig. 8

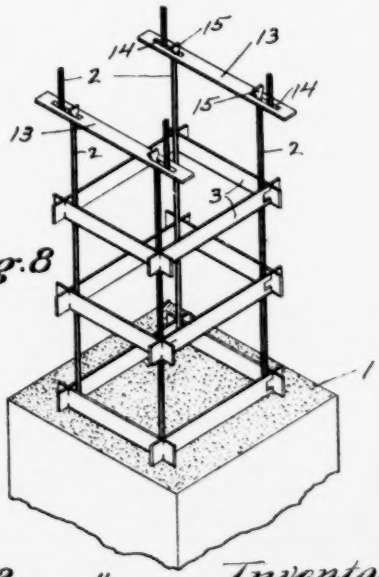


Fig. 4

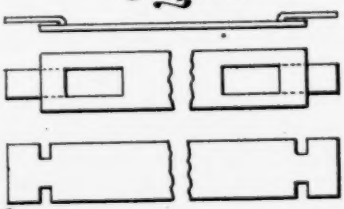
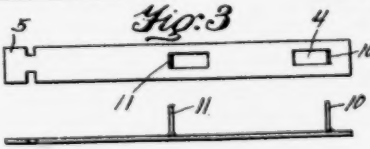


Fig. 3



Witnesses.
F. D. Lovell
Robt C. Litton

Inventor.
Robert A. Cummings
By Kay & Litton
Attorneys.

No. 764,883. Patented July 12, 1904.

UNITED STATES PATENT OFFICE.

ROBERT A. CUMMINGS, OF BEAVER, PENNSYLVANIA.

METAL-AND-CONCRETE COLUMN.

SPECIFICATION forming part of Letters Patent No. 764,883, dated July 12, 1904.

Application filed March 4, 1903. Serial No. 146,161. (No model.)

To all whom it may concern:

Be it known that I, ROBERT A. CUMMINGS, a resident of Beaver, in the county of Beaver and State of Pennsylvania, have invented a new and useful Improvement in Metal-and-Concrete Columns; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to concrete columns, piles, struts, and the like used in building structures, such as bridges, viaducts, docks, fireproof buildings, and other structures.

The object of my invention is to provide a column, pile, or strut for this purpose which is composed mainly of concrete and which will carry a much greater load than those heretofore constructed.

Concrete and cement, as is well known, possess great compressive strength when properly constructed and supported, and they also are not affected by fire, water, or other elements, and for these reasons are highly desirable in many building constructions. Attempt has heretofore been made to utilize the same for columns, piles, or struts, and with some degree of success. It has been found, however, that when subjected to very heavy loads such columns fracture upon conical lines, the apices of the cones being substantially at the center of the column. This fracture is, I believe, due to the slight tensile strength of the concrete, so that it is forced apart laterally by excessive stresses applied vertically thereto.

The object of my invention is to overcome this difficulty and to provide columns and the like made largely of concrete and wherein the liability to lateral spreading or fracture is entirely or largely overcome, thus enabling the column to carry a much heavier load than would otherwise be the case.

To this end my invention consists, generally stated, in embedding in the concrete column a series of metallic straps, bands, or strips, which encircle a considerable portion of the body of the concrete, and thus prevent it from spreading or fracturing laterally. Preferably these bands or strips will be used in connection with vertical tie-rods such as have heretofore been embedded in concrete columns, and the bands will also preferably be formed of strips united at their corners by slotted connections, which will permit of their ready assembling when building up the column. My invention also comprises certain details of construction hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a vertical section through the preferred form of my column. Fig. 2 is a horizontal section therethrough. Fig. 3 shows the details of construction of the bands or strips. Fig. 4 shows a modification of such bands. Fig. 5 is a horizontal section of a modified form of column. Fig. 6 is a view of the metal parts of still another modification. Fig. 7 is a horizontal section showing the idea applied to a round column, and Fig. 8 illustrates the manner of building columns in sections.

The essential idea underlying my invention consists in providing suitable means, preferably metallic, and embedded in the concrete column, pile, or the like and which encompasses or encircles all or a greater portion of the body of the concrete and prevents the same from spreading or fracturing laterally. This idea may be embodied in a large variety of specific constructions, and in the drawings I have shown the same adapted to a column having therein vertical rods, such as are now placed in concrete columns.

In the drawings the concrete is shown at 1 and the vertical rods at 2. The latter may be of various numbers and differently located, depending upon the size and shape of the column. In my preferred construction, however, I arrange these rods in pairs, as shown in Figs. 1 and 2, and with a square column, such as shown, a pair of rods will be located in each corner of the column, inside the outer face thereof, so that said rods will be entirely embedded or enveloped by the concrete, and thus protected from the elements.

At suitable intervals in the column are embedded strips or bands 3 of metal of suitable thickness and width and which act to prevent the concrete from spreading laterally. These strips or bands may be unattached to the rods 2 or may be united thereto in any suitable way. I prefer to unite the strips themselves

one to the other, so as to form practically a continuous band enveloping or surrounding the major portion of the body of the concrete. This can be conveniently accomplished by providing said strips at their meeting ends with suitable interlocking means—such, for instance, as providing one of the meeting ends with a slot 4 and providing the other meeting end with a head or enlargement 5, which latter is oblong or flat, as shown, and which can be passed through the slot 4, and then by giving the member on which it is formed a quarter-turn it will be locked in said slot, as will be readily understood. Any other convenient means, however, for uniting the ends of the strips may be employed—such, for instance, as rivets or any of the numerous interlocking means now well known in bale-ties and the like. In any event, however, the united strips will form practically a continuous band, and, if desired, a single band might accomplish the same purpose, said band having its ends suitably secured together. In the construction of round columns, such as shown in Fig. 7, the latter construction may be and preferably will be followed; but with rectangular or other polygonal shapes of columns I prefer to form the bands by uniting together a series of strips, one of which forms a side of the polygon. These strips or bands will be located in fairly close proximity one above the other and will be of such width that a substantial portion of the height of the column is surrounded by these bands. When the rods 2 are used, the bands may be secured to said rods in a variety of ways, and in the preferred form of my construction, wherein the rods 2 are arranged in pairs, the bands can be secured to the rods conveniently in the manner illustrated in Fig. 1—that is, by causing the rods to pass alternately inside and outside of the bands, as indicated—thus securing the bands in loops formed by the two rods. In this manner both rods will be held against lateral deflection by the bands, and it is possible to space the bands any desired distance apart by merely driving them down closer one with reference to the other. This arrangement also permits the position of the bands to be adjusted vertically when putting them in place.

With a column such as shown in Fig. 5, wherein a single rod only is used at each corner of the column, the bands 3 preferably will be placed outside of the rods, as shown, so as to hold the latter against outward deflection. If preferred, two rods may be used in each corner, one inside and the other outside of the bands, as shown in Fig. 6. In this case, however, the rods are not passed alternately inside and outside of the bands, as in Fig. 1. With round columns, as shown in Fig. 7, the bands preferably will be interwoven with the rods alternately inside and outside the same; but this is not necessary, as they may pass outside of all of the rods.

In building up columns according to my invention the rods 2 may or may not be employed. When such rods are used, they will be placed in vertical position and the bands 3 will be assembled therewith in any of the ways above described. A suitable mold, of wood or the like, is then built around the column, and the concrete is filled in and packed tight. The bands or strips 3 can be built up as the work proceeds, so that, in effect, the column will be built section by section, which is the most convenient way of doing the work. During the filling-up process it is necessary to hold the metal portions—that is, the rods 2 and strips 3—in proper position with reference to the center of the column. My manner of uniting the strips 3 to each other provides a convenient way of accomplishing this result. In forming the slots 4 the metal is punched out, but left attached at one end, and this punched-out portion will be bent outwardly, as indicated in Fig. 2, and provides a projection 10, which rests against the wooden mold surrounding the column, thus holding the metal structure in proper position with reference to the axis of the column. If desired, similar tongues may be punched out of the strips intermediate their ends, as shown at 11, Fig. 2. In filling the concrete in between and around the metal parts the latter are entirely embedded or enveloped in the concrete, thus protecting the metal from the action of the elements. The bands, however, encircle the major portion of the body of the concrete and prevent the same from spreading laterally, thus enabling the entire compressive strength of the concrete to be utilized in carrying the load.

In case the column is to be provided with a bracket or the like it will only be necessary to extend one or more of the strips 3 outwardly beyond the surface of the concrete of the column, as indicated at 12, Fig. 2, this projecting portion or portions serving as the horizontal part of the bracket.

By my invention it is possible to construct the columns in sections, this being illustrated in Fig. 8. Each of the sections is constructed practically in the way above described, composed of the concrete 1, vertical rods 2, and strips or bands 3. In addition to the latter each column-section will be provided at or near its end with plates or strips 13, which will be suitably united to the rods 2 of the section and which preferably will be provided with slots 14 for receiving projecting enlarged heads or ends 15 of the rods 2 of the next adjacent section. In constructing the columns in this manner the first section is built up in the ordinary way and at the top will be provided with the plates 13. The rods 2 of the next adjacent section are then passed through

the slots in the plates 13 and given a quarter-turn, thus locking them in place, and these rods are in turn connected by the strips or bands 3 and enveloped with concrete in the ordinary way. In this manner a column of any desired height can be easily constructed. When my invention is applied to piles, the latter will have a tube or tubes embedded therein to serve in sinking the piles and to permit the formation of a base thereunder by forcing concrete or cement down through the tubes.

Various modifications of the details of construction above described may be made without departing from the spirit of my invention, and I wish it understood that the claims are not limited to the precise details shown.

The strips or bands described practically form a skeleton envelop or casing for the concrete and prevent it from spreading laterally, thus preventing the fracture of the concrete on the conical lines, as heretofore, and greatly strengthening the same. The vertical rods 2 take care of the bending moment and are therefore desirable; but they are not absolutely necessary.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A column, pile, or the like, comprising a series of flat metallic strips provided with interlocking end portions and united thereby to form continuous bands, and concrete or the like enveloping and embedding said bands.

2. A column, pile or the like, comprising a series of metallic rods extending longitudinally of the column, a series of metallic strips having their meeting ends provided the one with a slot and the other with a head or enlargement whereby the same may be locked together to form a continuous band, and concrete or the like enveloping and embedding said bands and rods.

3. A column, pile or the like, comprising a series of metallic strips having their meeting ends the one provided with a head or enlargement and the other with a slot whereby the same may be united to form a continuous band, the metal punched out to form the slots being bent outwardly to form a tongue or projection for contacting with the mold, and concrete or the like enveloping and embedding said bands.

4. A column, pile or the like, comprising a series of metallic rods extending longitudinally of the column, a series of metallic strips connecting said rods, slots formed in said bands and having the punched-out portion bent outwardly to form projections to contact with the mold, and concrete or the like enveloping and embedding said strips and rods.

5. A column, pile, or the like, comprising a series of metallic strips or bands running transversely of the column, a series of rods extending longitudinally of the column and arranged in pairs, the rods of each pair passing alternately inside and outside of the bands, and concrete or the like embedding and enveloping said rods and bands.

6. A column, pile, or the like, comprising a series of metallic strips running transversely of the column and provided with interlocking end portions and united thereby to form continuous bands, a series of rods extending longitudinally of the column and arranged in pairs, the rods of each pair passing alternately inside and outside of the bands, and concrete or the like embedding and enveloping said bands and rods.

7. A column, pile, or the like, comprising a series of metallic rods extending longitudinally of the column, a series of metallic strips uniting said rods, and concrete or the like enveloping and embedding said strips and rods, one or more of said strips projecting laterally beyond said concrete to form a bracket.

8. A concrete-column section having longitudinal rods embedded therein and having plates secured to said rods at their ends, said rods projecting beyond the plates and provided with enlargements or heads, and said plates being provided with slots for receiving the ends of the rods of an adjacent section and locking the same thereto.

In testimony whereof I, the said ROBERT A. CUMMINGS, have hereunto set my hand.

ROBERT A. CUMMINGS.

Witnesses:
ROBERT C. TOTTEN,
G. KREMER.

No. 766,899. PATENTED AUG. 9, 1904.

F. POHLMANN.

CONCRETE OR LIKE GIRDER.

APPLICATION FILED JUNE 6, 1903.

NO MODEL.

Fig. 1.

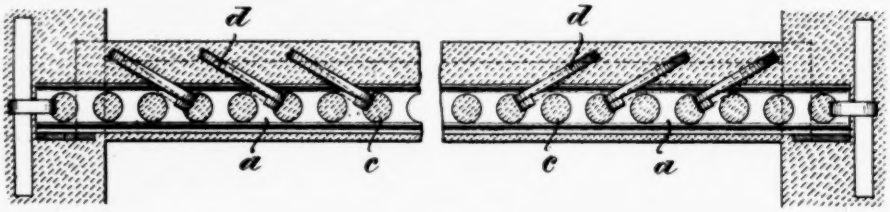


Fig. 2.

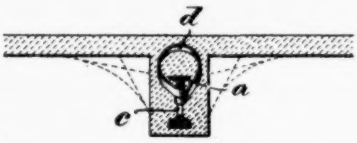


Fig. 3.

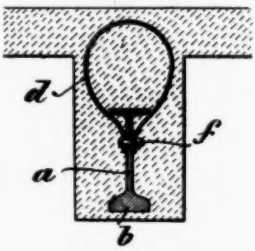


Fig. 4.

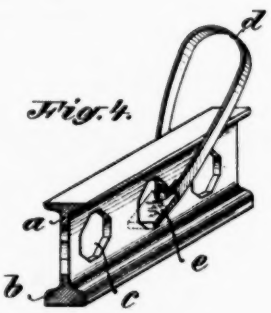


Fig. 5.

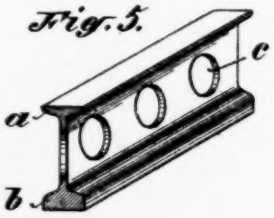
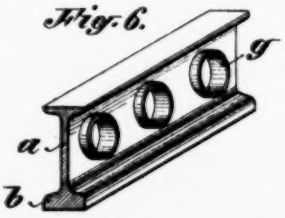


Fig. 6.



Witnesses:
Ed. L. Dieck
N. H. Robbins

Inventor:
Fritz Pohlmann
by Marcellus Bailey
Atty

No. 766,899. Patented August 9, 1904.

UNITED STATES PATENT OFFICE.

FRITZ POHLMANN, OF SCHÖNEBERG-BERLIN, GERMANY.

CONCRETE OR LIKE GIRDER.

SPECIFICATION forming part of Letters Patent No. 766,899, dated August 9, 1904.

Application filed June 6, 1903. Serial No. 160,379. (No model.)

To all whom it may concern:

Be it known that I, FRITZ POHLMANN, a subject of the King of Prussia, residing at No. 37 Hohenstaufenstrasse, Schöneberg-Berlin, Kingdom of Prussia, German Empire, have invented new and useful Improvements in Concrete or Similar Girders, of which the following is a specification.

This invention relates to a new construction of concrete girder by means of which a considerable saving in iron can be effected by statically utilizing the filling material forming the connection between the ceilings and the girder.

In the accompanying drawings, Figure 1 is a longitudinal section, partly in elevation, of a concrete girder constructed in accordance with this invention. Fig. 2 s a transverse section of the same. Fig. 3 is a sectional view of the iron girder and loop. Fig. 4 is a similar view of a perforated iron girder and loop. Fig. 5 is a perspective view of the perforated iron girder. Fig. 6 is a perspective view of the iron girder with flanged holes.

Like letters indicate like parts throughout the drawings.

The upper iron flange and the upper half of an ordinary I-girder *a* is partly replaced by concrete material. A similar construction is known in armored concrete girders, where the lower flange of the girder is replaced by bar (round or square) iron surrounded by concrete; but in that case there is the drawback that the iron armor in itself before the stone or concrete material has been added has little or no stability. This drawback is obviated in the present invention by using strong rolled-iron beams *b* for the part exposed to tensile stress. Its bending strength is calculated to be sufficient for supporting the weight of the wooden binding-joists required for making the ceiling and the weight of the stone or concrete itself. In this way there is no necessity for supporting the binding-joists by scaffolding, and said binding-joists can be attached direct to the iron part in the same way as for ordinary girders, besides which the ceilings need not be made until after the roof has been completed, as the iron part of the girder sufficiently strengthens the walls. In order to make the iron part of suitable shape for its action in the stone, the mass of metal is concentrated at the part *b* subjected to the greatest stress. The cross-section is therefore unsymmetrical relatively to the horizontal axis, and the tensile stress produced in the concrete girder is taken up by the lower thickened flange *b* of the iron girder. The sheering stress acting on the concrete girder is taken up by connecting the iron part with the stone or concrete material in the best possible way. This connection is effected partly by the adhesion of iron and concrete and partly by mechanical means.

The iron part is provided throughout the whole of its length with holes *c*, arranged at small intervals and of such height as to occupy nearly the whole height of the web. When embedded in the concrete, the filled holes transmit the sheering stress produced by the tensile strains on the perforations of the iron, acting as stone rivets. In order to obtain a greater bearing-surface in the perforated girders, the holes can be provided with flanges *g*, Fig. 6.

For increasing the resistance against tensile stress metal bands or loops *d* may be attached near the ends of the iron girders by screws *f*, rivets, or the like, or they may be passed through the holes *c*, Figs. 1, 3, and 4, and secured in their position by wedges or stays *e*, Fig. 4.

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. In a concrete girder the combination with the concrete material, of a metal beam having an upper flange and a lower flange of greater thickness than the upper flange and a web provided with perforations extending from near the lower flange to near the upper flange.

2. In a concrete girder the combination with the concrete material, of a metal beam having an upper flange and a lower flange of greater thickness than the upper flange and a web provided with flanged perforations extending from near the lower flange to near the upper flange.

3. In a concrete or similar girder in combination with the concrete material of a metal

beam having a lower thickened flange and web with metal bands or loops attached thereto, substantially as and for the purpose stated.

4. In a concrete or similar girder the combination, of the concrete material with a metal beam having a lower thickened flange, web provided with holes, and metal bands or loops secured in said holes, substantially as and for the purpose stated.

5. In a concrete or similar girder the combination, of the concrete material with a metal beam having a lower thickened flange, web provided with holes, and metal bands or loops passed through the holes and secured in their position by wedges or stays, substantially as and for the purpose stated.

In testimony whereof I have hereunto set my hand in presence of two subcribing witnesses.

FRITZ POHLMANN.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.

No. 805,663. PATENTED NOV. 28, 1905.

G. L. PEABODY.

REINFORCING DEVICE FOR CONCRETE CONSTRUCTION.

APPLICATION FILED SEPT 29, 1904.

Fig. 1.

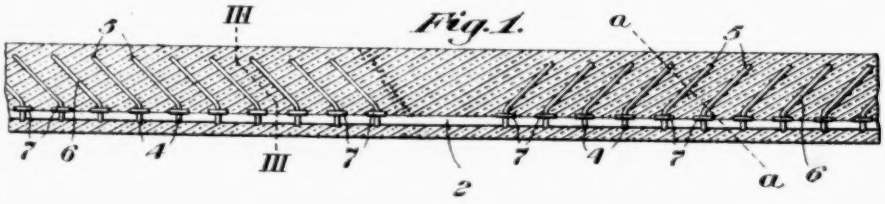


Fig. 2.

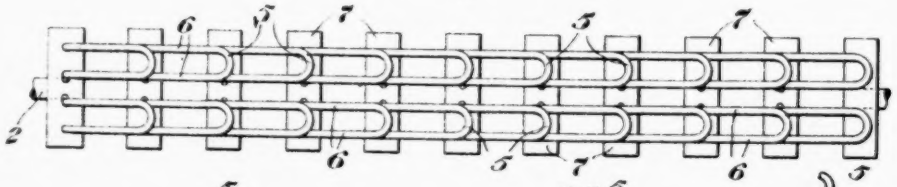


Fig. 3.

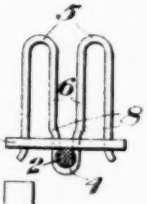


Fig. 4.

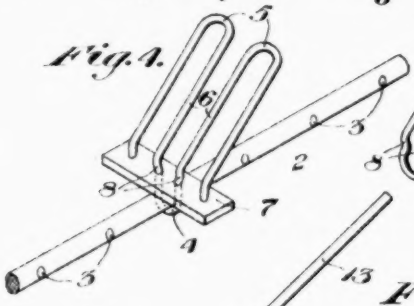


Fig. 5.

Fig. 8.

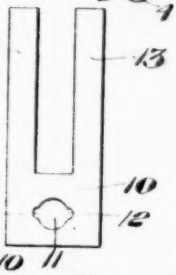


Fig. 6.

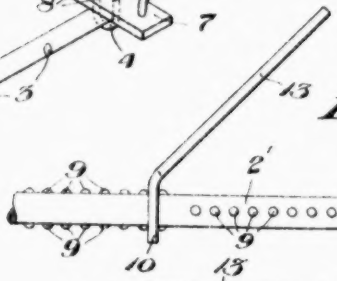


Fig. 9.

Fig. 7.

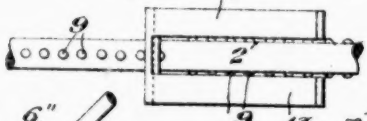


Fig. 10.

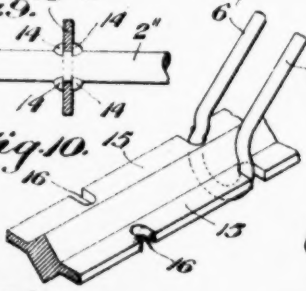


Fig. 11.

Fig. 12.

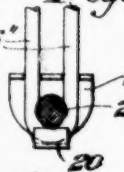


Fig. 13.

Witnesses:

A. H. King

Chas. S. Pepley

Inventor:

George L. Peabody

by C. M. Clarke

his attorney

UNITED STATES PATENT OFFICE.

GEORGE L. PEABODY, OF PITTSBURG, PENNSYLVANIA

REINFORCING DEVICE FOR CONCRETE CONSTRUCTION.

No. 805,663. Specification of Letters Patent. Patented Nov. 28, 1905

Application filed September 29, 1904. Serial No. 226,528.

To all whom it may concern:

Be it known that I, GEORGE L. PEABODY, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Reinforcing Devices for Concrete Constructions, of which the following is a specification, reference being had therein to the accompanying drawings, forming part of the specification, in which—

Figure 1 is a view in side elevation of a portion of concrete construction provided with my improved reinforcing device. Fig. 2 is a plan view, on an enlarged scale, of one end of the device. Fig. 3 is a vertical cross-sectional view on the line III III of Fig. 1. Fig. 4 is a perspective view of the portion of the bar with one of the anchoring devices attached thereto. Fig. 5 is a modified form of holding-arm. Fig. 6 illustrates in side elevation a modified construction. Fig. 7 is a plan view of Fig. 6. Fig. 8 is an end view. Fig. 9 is a detail view showing the bar pinched around the plate. Fig. 10 is a detail view showing a different form of bar. Figs. 11 and 12 show a modified construction employing a supplemental holding-clip. Fig. 13 is a detail view showing the clip detached.

My invention relates to improvements in devices for incorporation with concrete structures—as bridges, beams, girders, walls, ceilings, floors, columns, &c.; and it has for its object to strengthen and reinforce the concrete body portion constituting the floor, &c., embedded therein and provided with projecting arms or branches arranged at any angle desired and so constructed as to be adjusted to suit the requirements of use and to make and maintain a strong binding hold in the cement or concrete at closely-adjacent intervals.

The invention is designed to provide a reinforcing device which will be capable of incorporation with the concrete in such a manner as to traverse the lines of probable fracture and counteract such fracture in the best possible manner, the device being provided with a closely-adjacent plurality of such arms or with arms or branches which may be adjusted to the intervals desired or required by the work in view.

Referring now to the drawings, 2 represents the main element of the device consisting of a bar of metal of any suitable cross-section, but preferably cylindrical. The bar is provided at intervals with notches or grooves 3 on opposite sides, around which are passed the looped portion 4 of the arms, which are then extended upwardly beyond the bar 2 and bent at any desired angle and looped, as at 5. The arms are made of a heavy wire or rod 6 and may be then turned backwardly, as shown in the principal figures of the drawings, and their terminal portions connected in a cross bar or clamp 7 of any suitable construction, by which the entire arm may be tightly secured in position and to the bar 2. For the purpose of insuring the gripping action of the arms upon the bar they may be abruptly bent, as at 8, thereby forming a shoulder on the upper side of bar 7, so as to prevent their loosening or removal, and as thus constructed the arms will be rigidly attached to the main bar. It will be seen that the arms may be closely assembled, as indicated in Figs. 1 and 2, and that as thus located they cross the line of fracture, as *a a*, at least three times, thereby providing strong counteracting reinforcing devices, which effectually perform their functions. It is designed that the arms may be incorporated with the main bar at the place where used—as, for instance, in a building under construction—which feature greatly facilitates the shipment and handling of the different parts, their assemblage being a matter of simple and easy accomplishment by any mechanic.

It will be understood that any suitable device may be used for the arms, and in Figs. 6, 7, and 8 I have shown a bar 2′, provided with series of abutments 9, located in oppositely-arranged series of rows with an intervening space between the abutments for the insertion of a holding-arm of the character shown in these figures, made of a plate of sheet metal 10, having an aperture 11 for the bar and registering openings or slots 12 to facilitate its insertion upon the bar, the plate being provided with one or more upwardly-bent projections 13, arranged at any suitable or desired angle, as already described.

In Fig. 9 the bar 2″ is originally smooth on its exterior, the plate 10 or any other suitable branch device being provided with a corresponding aperture slipped over the bar and secured thereon by holding-lugs 14, pinched or upset from the metal of the bar, so as to securely bind on each side of the plate and hold it in position, the plates being thus attached at any desired interval apart.

In Fig. 10 the bar is shown as provided with lateral flanges 15 15, having notches or apertures 16 at the desired distances apart,

which engage the arms 6', as shown, the arms being tightened or fastened upon the bar in any suitable manner.

In Figs. 11 and 12 the bar is provided with the notches 3, already described, the arm extremities 6'' being attached in the manner shown, and are further secured by a supplemental clip 17, consisting of a plate of sheet metal having an opening 18 for the bar and apertures 19 in its upper edge, which edge may be bent over, the clip being provided with a terminal tongue 20, which is bent up around the lower portion of the arms, as shown, thereby securely attaching it to the main bar.

All of these various devices are suitable for the objects in view and provide a main bar having rigidly-connected projecting arms capable of being bent to any desired angle and to maintain their position with relation to the bar, so as to transmit to it the various strains to which the concrete structure is subjected.

It will be understood that various other devices or constructions of holding-arms may be incorporated with the bar, and all such various changes or modifications which may be made by the skilled mechanic are to be considered as within the scope of the following claims, as I do not desire to be limited to the exact construction shown and described.

Having described my invention, what I claim is—

1. A reinforcing device for concrete, &c., consisting of a main bar provided with a series of notches, and holding-arms surrounding the bar in engagement with said notches and projecting laterally from the bar, substantially as set forth.

2. A reinforcing device for concrete, &c., consisting of a main bar provided with a series of notches, holding-arms surrounding the bar in engagement with said notches and projecting laterally from the bar, with securing devices for the arms, substantially as set forth.

3. The combination with a main bar provided with a series of notches formed between adjacent shoulders, of holding-arms surrounding the bar and in engagement with said shoulders, and provided with apertures adapted to provide clearance therefor in assembling the arms with the bar, substantially as set forth.

4. The combination with a main bar provided with a series of notches, of oppositely-disposed series of holding-arms surrounding the bar in engagement with said notches and projecting laterally from the bar and toward each end respectively beyond its middle portion, substantially as set forth.

5. A reinforcing device for concrete, &c., consisting of a main bar provided with a series of notches, and holding-arms surrounding the bar in engagement with said notches and projecting upwardly and outwardly toward the ends of the bar, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE L. PEABODY.

Witnesses:
R. H. McLARN.
C. M. CLARKE.

No. 815,157. PATENTED MAR. 13, 1906.

J. F. GOLDING.

TENSION BAR FOR USE IN CONCRETE AND THE LIKE.

APPLICATION FILED FEB. 20, 1905.

Fig. 1.

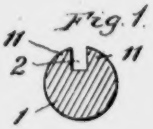


Fig. 2.

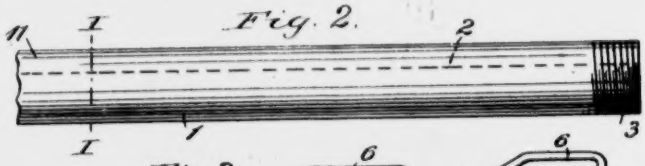


Fig. 3.

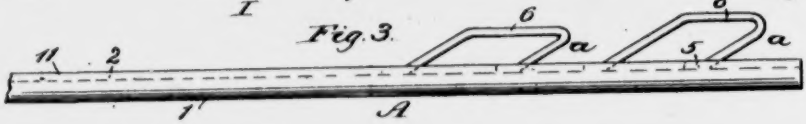


Fig. 4

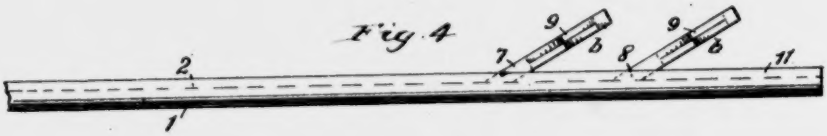


Fig. 5.

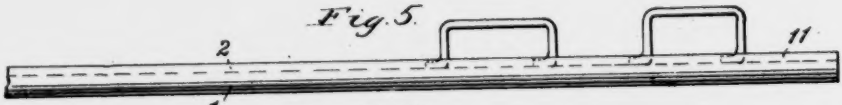


Fig. 7.

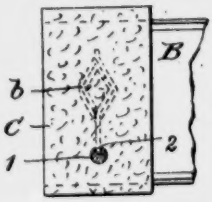


Fig. 10

Fig. 6.

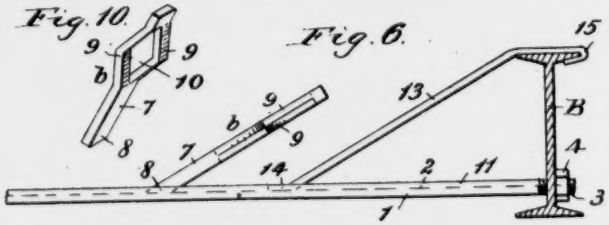


Fig. 8.

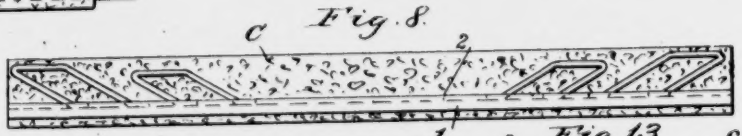


Fig. 9.

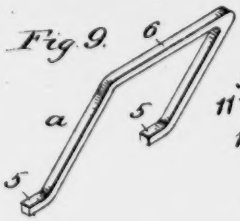


Fig. 11.

Fig. 12.

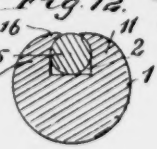
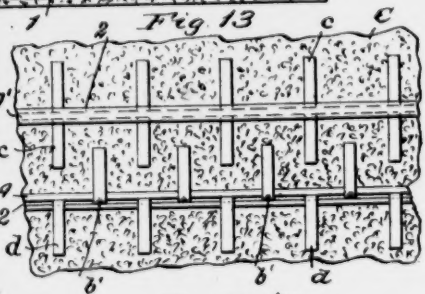


Fig. 13



Witnesses:
G. S. Barker
H. B. Pitts.

Inventor:
John F. Golding
by H. N. Low
atty.

UNITED STATES PATENT OFFICE.

JOHN F. GOLDING, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO MONOLITH STEEL COMPANY, INCORPORATED, A CORPORATION OF VIRGINIA.

TENSION-BAR FOR USE IN CONCRETE AND THE LIKE.

No. 815,157. Specification of Letters Patent. Patented March 13, 1906.

Application filed February 20, 1905. Serial No. 246,609.

To all whom it may concern:

Be it known that I, JOHN FRENCH GOLDING, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Tension-Bars for Use in Concrete and the Like, of which the following is a specification.

My invention relates to the strengthening of cement, concrete, and the like where these materials are employed in various structures; and it consists in a tension-bar adapted to be embedded in or surrounded by such materials, the bar comprising a main longitudinal member and inclined members provided with concrete engaging or locking portions which are so arranged as to obtain a positive hold upon the material at a distance from the bar as distinguished from a mere skin frictional engagement, whereby the cracking of the material is prevented when the structure is subjected to strain and the separation of the different parts of the body of material from each other or from the said main member is rendered impossible.

It further consists in a tension-bar of peculiar construction; also, in such a bar suitably embedded in concrete or the like; also, in the parts and combinations thereof hereinafter set forth and claimed.

In order to make the invention clearly understood, I have shown in the accompanying drawings means for carrying the same into practical effect without limiting my improvements in their useful applications to the precise constructions and arrangements which, for the sake of example, I have delineated.

In said drawings, Figure 1 is a sectional view of the main longitudinal member of a tension-bar embodying my invention on line I of Fig. 2. Fig. 2 is a side view of a portion of said main member. Fig. 3 is a side view, on a smaller scale, of a portion of my improved tension-bar, showing two of the inclined or supplemental members combined with the main longitudinal member. Fig. 4 is a similar view showing supplemental members of a different form also embodying the invention. Fig. 5 is a side view showing another form of supplemental member. Fig. 6 is a side view, partly in section, of a portion of the tension-bar united with one of the floor-beams. Fig. 7 is a sectional view at right angles to Fig. 6, showing also the body of concrete around the tension-bar. Fig. 8 is a vertical sectional view of a concrete floor or beam containing a tension-bar of the form shown in Fig. 3. Figs. 9 and 10 are perspective views of the supplemental members shown, respectively, in Figs 3 and 4. Figs. 11 and 12 are sectional views across the tension-bar at the point where it is united with a supplemental member, said views showing, respectively, a supplemental member of square cross-section and one of round cross-section. Fig. 13 is a plan view, partly in section, of a portion of a floor having tension-bars embodying my invention, in this instance the supplemental members extending horizontally on each side of the grooved member.

I have herein shown and described the tension-bar as combined in a floor; but it will be understood that the invention is not confined to use in such particular structure. The word "concrete" as used herein is intended to cover all built-up structures of similar or analogous materials.

Referring to the drawings, 1 indicates the main or longitudinal member of the tension-bar A, made of suitable material, such as iron or steel, to have the necessary tensile strength. The member 1 is rolled or otherwise formed with a longitudinal surface-groove 2, extending for a portion of or by preference for the entire length of the member, and leaving a relatively heavy main body from and beyond which extend the opposing lips 11. When the bar A is combined in a floor, as shown in Figs. 7 and 8, the member 1 is laid substantially horizontally with the groove 2 on the upper side. The member 1 is or may be provided at its ends with screw-threads 3 and nuts 4, as indicated in Figs. 2 and 6.

In Fig. 3 the supplemental members are shown at *a* extending in an inclined direction upward and away from the member 1. They are provided with feet 5, securely held in the groove 2 and at a distance from the member 1, with concrete engaging or locking portions 6 arranged crosswise of or at an angle to the general direction of the supplemental member, so as to obtain a positive hold or lock on or in the concrete. Thus the portions 6 may be parallel with the member 1, as shown in Figs. 3, 5, and 8. In this particular construction of supplemental member (shown at *a*) it is formed of a bar of metal the middle of which

forms the engaging or locking part 6, the ends of which are legs extending in an inclined direction to the member 1 and the extremes of which constitute the feet 5. In order to effect the most economical distribution of metal, I usually prefer to make the supplemental members progressively a little longer or higher as the end of the main bar is approached, as indicated in Figs. 3, 5, and 8.

Another form of supplemental member is shown in Figs. 4, 6, 7, and 10 at *b*, the same having a single leg 7 and foot 8. The concrete engaging or locking portions are formed by the limbs 9 of eyes or loops 10. The latter are of diamond or other suitable shape. The members shown at *b* are or may be short sections of the tension-bar which is the subject of my Patent No. 758,061, dated April 26, 1904. The legs of the supplemental members may extend at right angles to the bar 1 instead of being inclined, as seen in Fig. 5.

The tension-rod described is or may be delivered in a knockdown condition, the supplemental members separate from the main member 1. The parts are then assembled according to the requirements of the floor or other structure, the supplemental members being spaced apart or arranged as desired in the groove 2 of the member 1, and the feet of the supplemental members are secured by forcing inward the lips or parts 11, which extend outward from and beyond the main body of the member 1, with a suitable press or swage, so as to permanently set the metal of the member 1 against or onto the sides of the supplemental members. The tension-bar A may, however, be completed for use at the factory, in which case the parts may be permanently united by a rolling process, the bar with the supplemental members inserted in its groove being passed between grooved rollers suitably shaped to upset, bend, or compress the metal of the member 1, as desired.

The preferred manner of attaching the tension-bar to the supporting-beams is shown in Fig. 6, where one of such beams is indicated at B. The end of the member 1 is inserted through an aperture in the lower part of the vertical web of the beam, and the nut 4 is set up against the web. The other end of the member is similarly secured to another beam. 13 is a tie-rod having a foot 14 secured in the described manner in the groove 2 and which extends thence in an inclined direction to the top of the beam, where it is provided with a hook 15, which engages the top flange or other convenient part of the beam. The tie strengthens and supports the member 1, strengthens the concrete at one of its points most subject to heavy strain, and keeps the tension-bar A upright during building.

The supplemental members may be of square, round, or other cross-section. The thickness of the supplemental member or of its foot may be a little less than the depth of the groove 2, Figs. 11 and 12, in which case the edges of the groove are or may be bent partly over or around the foot of the supplemental member, as indicated at 16 in said figures.

C is a body of concrete representing a floor, beam, or other structural element. It incloses the bar A and enters the spaces between or within the supplemental members.

In Fig. 13 I have shown supplemental members consisting of plain straight bars secured in the grooved bars, as already described. In this construction the supplemental members are arranged horizontally. The bar shown at A′ has two of the described grooves opposite to each other, one on each side of the bar, and the supplemental members *c* are secured some in one groove and some in the other, extending in opposite directions from the grooved bar. The bar shown at A is similar to that shown in the other figures and has the groove on its upper side. The supplemental members *d* have downwardly-bent feet *b*′, seated in the groove 2, and thence extend horizontally to each side of the bar A.

Where tension-bars are constructed with the supplemental or concrete-locking members integral with the part or parts that act as tension members, the latter cannot well be of the highest tensile strength on account of the concomitant hardness and the difficulty of cutting and forming the supplemental members from it. My present improvement allows the member 1 to be made of the highest tensile strength without encountering said difficulty, and I can get the same structural strength with less metal and weight. Also I am enabled to closely adapt the tension-bar at the place of building to the requirements of the structure, doing away with the necessity of having made to order at the factory in complete form the various tension-bars for the different parts of the building. It will be further noticed that the described means for securing the supplemental members to the member 1 leaves to the latter the full tensile strength of the metal which is contained in it. In other words, there is no metal which is wasted for tensile purposes, as would be the case if the member 1 were perforated or cut away on transverse lines.

The feet of the supplemental members are extended longitudinally in the groove of the main bar sufficiently to enable the bar to have a firm and secure hold on the supplemental member. This may be effected in different ways—for instance, by making the supplemental member wide in the direction of the groove, as shown at 8, Figs. 6 and 10, or by bending such feet in a direction parallel with the groove, as shown at 5, Figs. 3 and 9. It is to be understood that the word "ten-

sion" is herein used in connection with the bar 1 to indicate its general function in receiving the strains imposed by the concrete and its load and not in such a narrow sense as to exclude the use of my improvement from columns or other situations in which it would receive other than simple tension strains. Important advantages result from making the main bar 1 with a continuous groove or grooves. When of such shape, it can be very economically produced by a rolling process. The groove-producing flange of the roll enters and rolls and finishes the interior of the bar to a material degree, thereby giving to the bar an extra amount of rolled tough skin or surface and increased tensile strength. The bar is or may be of uniform cross-section, having no waste metal which is not utilized for strengthening purposes. The supplemental members can be arranged at any desired points along the bar, according to the requirements of the structure or building, and there secured with the greatest firmness. The grooves at their portions which are not occupied by the supplemental members are open to receive the concrete or cement and unite the bar with the same against lateral strains, giving the bar also a strong frictional hold on the concrete to prevent longitudinal displacement. In assembling the supplemental members with the bar the former will readily become seated in the groove without its being necessary to exercise great particularity as to their exact location longitudinally of the bar. The parts can be united by a simple rolling process, the bar having the supplemental members inserted in its groove or grooves being passed between rolls, which act on it from end to end and bring the walls of the groove or grooves to bear securely against the sides of the supplemental members. If the bar is not of too great cross-section, such assembling-rolls may compress the bar as a whole to bring the walls of the grooves nearer together; but my improvements are not to be limited to such precise mode of securing the parts together. If the bar be of such size that it cannot be readily compressed as a whole, I may cause the rolls to act along those parts of the bar between which the groove is situated or I may use a swaging process, as already explained.

What I claim is—

1. The combination, with a body of concrete, of a metal bar supporting such concrete and formed with a continuous longitudinal groove, and one or more supplemental members arranged in said groove at the desired points in the length of the bar and secured in the groove, substantially as and for the purposes described.

2. A metal strengthening-bar for use in concrete and the like, said bar being formed with a continuous longitudinal groove, in combination with one or more supplemental members adjustable along the groove of the bar to the desired points, the bar being adapted to be upset to secure the supplemental members, substantially as and for the purposes described.

3. The combination, with a body of concrete, of a metal bar surrounded by such concrete and formed with a continuous longitudinal groove, and one or more supplemental members secured in such groove, the open portion of the groove being adapted to receive therein, and obtain a hold on, the concrete, substantially as and for the purposes described.

4. A tension-bar for use in concrete and other purposes, consisting of a main, longitudinal, continuously-grooved member, and supplemental members arranged at desired points along the groove of said main member and having their feet or ends extending longitudinally in the groove, the metal of the main member being permanently upset to cause the walls of the groove to rigidly secure said supplemental members, substantially as set forth.

5. A tension-bar consisting of a main, longitudinally and continuously grooved member 1, and a supplemental member *a* formed with a longitudinal portion 6 arranged at a distance from the main member and with legs extending to said main member, the ends of said legs being arranged within the groove of the main member and the metal of the main member being permanently upset to cause the walls of the groove to rigidly secure such ends, substantially as set forth.

6. A tension-bar adapted to be supplied in an unassembled or knockdown condition, consisting of a main longitudinal member formed with a continuous groove 2, and supplemental members having parts fitting said groove and adapted to be arranged along such groove and spaced apart as desired, the main member being of malleable material for the securing of the supplemental members by the permanent upsetting of the material of the main member as described.

7. The combination of the tension-bar, consisting of a longitudinal and continuously-grooved member, beams supporting the ends of said longitudinal member and a tie engaging the upper part of the beam, extending in an inclined direction to said longitudinal member and having its end or foot secured by compression in the groove of the longitudinal member, substantially as set forth.

8. In combination with a body of concrete or the like, a tension-bar consisting of a main longitudinal member having a relatively heavy main body and formed with opposing lips extending outward from and beyond the main body, such lips producing a continuous groove wherein the concrete can enter, and

supplemental members arranged at desired points along the said main member and having their feet or ends between such lips, such main member having its metal permamently upset to cause the lips to rigidly secure such supplemental members, and said body of concrete being arranged to surround and engage the bar and the supplemental members and to enter between said lips of the bar, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN F. GOLDING.

Witnesses:
H. N. Low,
Wm. H. De Lacy.

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No. 815,409. PATENTED MAR. 20, 1906.

R. A. CUMMINGS.

CONCRETE AND METAL STRUCTURE.

APPLICATION FILED OCT. 1, 1904.

2 SHEETS—SHEET 1.

FIG. 1

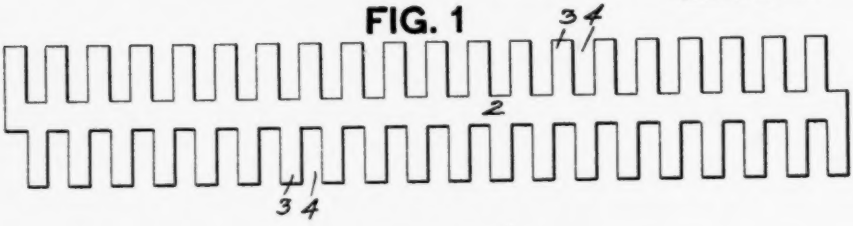


FIG. 2

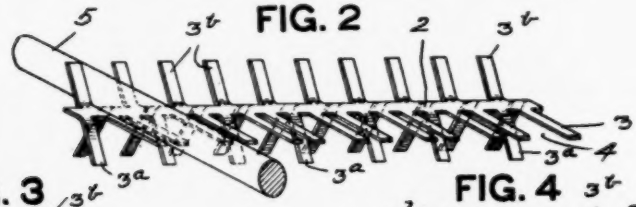


FIG. 3

FIG. 4

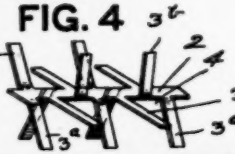


FIG. 5

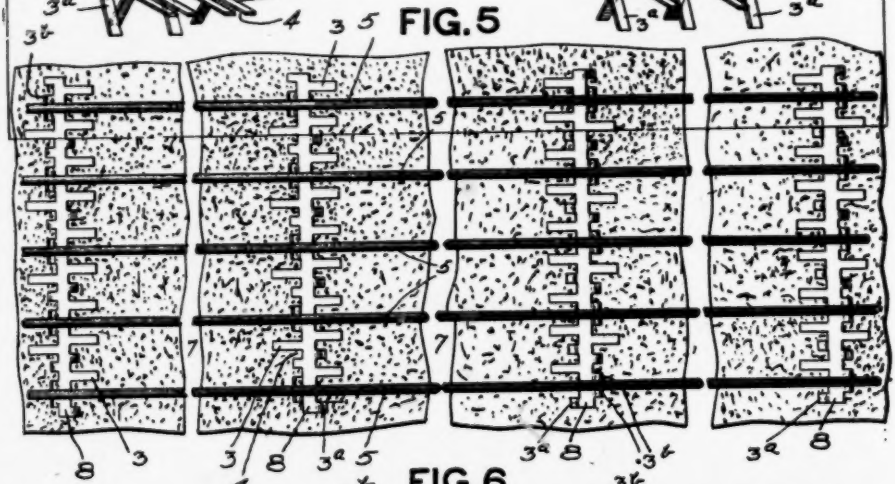
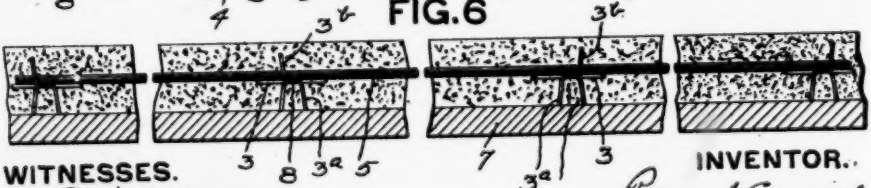


FIG. 6



WITNESSES.

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No. 815,409. PATENTED MAR. 20, 1906.

R. A. CUMMINGS.

CONCRETE AND METAL STRUCTURE.

APPLICATION FILED OCT. 1, 1904.

2 SHEETS—SHEET 2.

FIG. 7

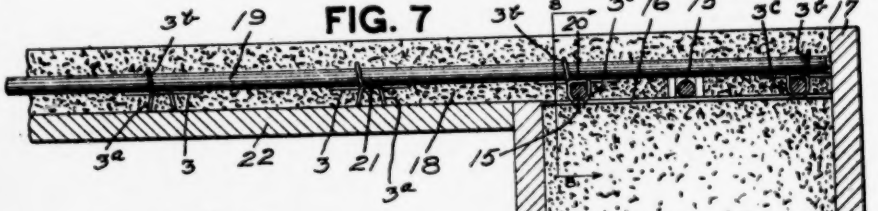
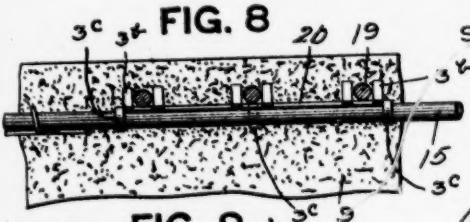


FIG. 8



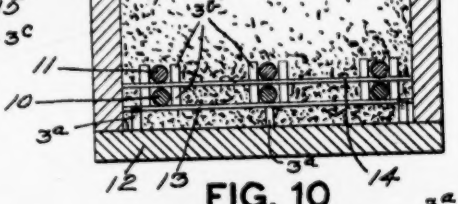


FIG. 9

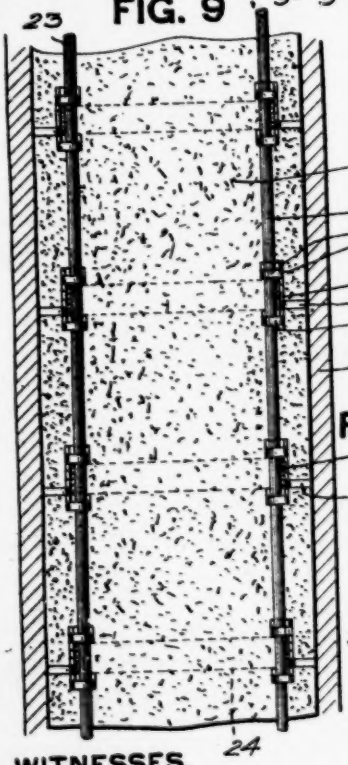


FIG. 10

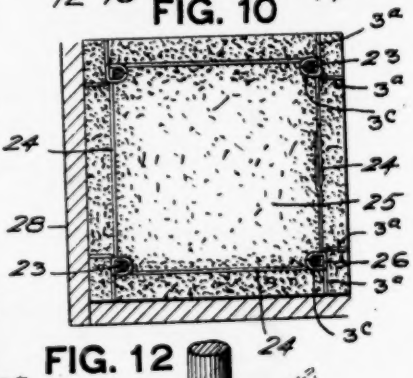


FIG. 11

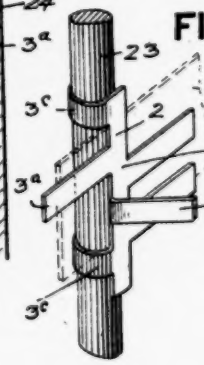
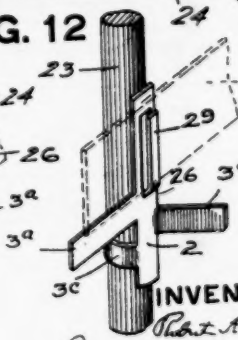


FIG. 12



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UNITED STATES PATENT OFFICE.

ROBERT A. CUMMINGS, OF BEAVER, PENNSYLVANIA.

CONCRETE AND METAL STRUCTURE.

No. 815,409. Specification of Letters Patent. Patented March 20, 1906.

Application filed October 1, 1904. Serial No. 226,821.

To all whom it may concern:

Be it known that I, ROBERT A. CUMMINGS, a resident of Beaver, in the county of Beaver and State of Pennsylvania, have invented a new and useful Improvement in Concrete and Metal Structures; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to composite metal and concrete structures, such as bridges, viaducts, reservoirs, floors, roofs, walls, columns, piles, struts, and other portions of fireproof buildings and other structures.

The object of my invention is to provide a spacing and supporting member for holding the metal reinforcements of the concrete in proper position relative to each other and to the centering or casing used in forming the concrete.

Concrete and cement are at present very largely used for building many kinds of structures which formerly were built of metal, masonry, or the like. The concrete possesses great compressive strength when properly constructed and supported and is not affected by fire, water, or other elements and for these reasons is highly desirable in many building constructions. It, however, possesses very little tensile strength, and therefore it is customary to reinforce the same by embedding in it suitable metallic reinforcing members or bars, known technically as "core bars" or "units," which supply the requisite tensile strength to the material. It is the custom to place the metallic reinforcing members in position in the structure and in proper relation with reference to the centering or casing onto or into which the cement is to be filled and then to fill the cement into the casing or onto the centering and around the reinforcing members. These metallic reinforcing members very frequently are of light weight, being either thin metallic bands or rods from one-fourth inch upward in dimensions. They therefore are quite flexible and difficulty is experienced in holding them in proper relative position one to the other and also in proper position with relation to the centering or casing. This is essential in order that these members may be so distributed in the concrete as to give the greatest strength thereto.

My invention relates especially to means for holding the reinforcing members in proper relative position one to the other and to the centering or casing.

The invention consists, generally stated, in a supporting and spacing member formed, preferably, of sheet metal and provided at its edges with projecting tongues or fingers which are adapted to be bent some in one direction and some in the other, those bent in one direction serving to space this member and the reinforcing members supported thereby the proper distance from the centering or casing and those bent in the opposite direction serving to hold the reinforcing members the proper distances apart.

In the accompanying drawings, Figure 1 is a plan view of a metal sheet cut to the proper form for making the supporting and spacing member. Fig. 2 is a perspective view of a completed member, showing the manner of holding the core-bars. Figs. 3 and 4 are similar views showing modifications. Fig. 5 is a plan view showing the manner of applying the spacing members in the formation of floor and similar concrete structures. Fig. 6 is a section on the line 6 6, Fig. 5. Fig. 7 is a section showing the application of the spacing member to girder constructions. Fig. 8 is a section on the line 8 8, Fig. 7. Fig. 9 is a vertical section showing the application of the supporting and spacing member to the building up of a column and the like. Fig. 10 is a horizontal section through the same. Fig. 11 is a perspective detail of the column-work, and Fig. 12 is a similar view showing a modification.

My invention comprises a supporting and spacing member having a body designed to be placed horizontally or vertically, according to the character of work to be performed, and provided on its longitudinal side edges with projecting tongues, fingers, or the like, some of which may be bent in one direction and some in another. This supporting and spacing member may be formed of wire, malleable casting, or other material. Preferably it will be formed of sheet metal of a thickness depending on the character of work. In some cases it may be of exceedingly thin metal—say twenty-eight gage; but for heavier work it will be materially thicker. This sheet metal will be used in the form of strips and of a length varying with the work to be performed. Each strip is provided with its side edges provided with slits, so as to form tongues or projections.

In Fig. 1 is shown a suitable strip cut to form a spacing member. This strip has the central longitudinal unslitted body portion

2 and on the edges is provided with projecting tongues 3, separated by interdental spaces 4. These spaces 4 might be so narrow as to form mere slits; but it is preferred to have a portion of the metal removed, so as to make comparatively wide spaces. Some of the projecting tongues 3 will be bent in one direction to form the legs or distance members 3^a, and others will be bent in the opposite direction to form the means 3^b for spacing the reinforcing members or core-bars 5. Preferably the projections or tongues will be arranged alternately on the two sides, as shown in Fig. 1, instead of opposite each other, as thereby greater flexibility in spacing the core-bars or a greater range of dimensions of the spaces between the upturned members can be obtained. Any of the projecting tongues may be turned upwardly, as desired or necessary, to form holding means properly spaced apart for the metallic reinforcing members, while other of said tongues can be turned down to form the necessary number of distance pieces or legs. The number turned up will vary according to the number of reinforcing members to be held by the spacing member and the distances between adjacent ones will vary largely. Fig. 3 shows two adjacent fingers on the same side turned up, thus forming a narrow space for holding a small core-bar. Fig. 4 shows one finger on one side and another on the other side turned up to form a wide space for a larger core-bar, and Fig. 2 shows the two turned-up fingers on the same side of the strip, but not adjacent ones, thus making a still wider space for a large core-bar. The number turned down to form the legs will be sufficient to properly support the member and reinforcements in proper position with reference to the centering or casing. All other projections or tongues can be left unbent. The blank shown in Fig. 1 is a standard blank which can be adapted at the place of use to a variety of uses and to various numbers or characters of metallic reinforcing members to be held thereby, the projecting tongues being capable of being bent into place by hand or by a simple tool. It will be necessary only to stamp out the sheet-metal blanks to the form shown in Fig. 1 and then carry the same to the place of use. This one blank will be sufficient for any use to which it can be put. If desired, different sizes or weights of blanks can be manufactured; but a single one will be found suitable for most purposes. This spacing member can be used in a large variety of ways, and in the drawings I have shown several manners of applying the same; but it will be understood that these are for purposes of illustration largely and do not show all manners of using the same.

In Figs. 5 and 6 the spacing member is shown applied in the formation of floors, roofs, and similar structures. The centering is shown at 7, and the spacing members 8 are placed upon the same, having the legs 3^a resting thereupon. The reinforcing members or core-bars are shown at 5, and the spacing member will have as many fingers 3^b turned upwardly as will be necessary to hold the core-bars in the proper relative position with reference to each other. The body 2 of the spacing members lies in a horizontal plane and merely serves as a support upon which the reinforcements rest. The legs 3^b of course can be made of any desired length so as to hold the reinforcements the proper distance above the centering. As many spacing-pieces will be used as necessary to support the reinforcements along their entire length. The concrete is filled onto the centering and around these reinforcements and spacing members in the usual way, and when said concrete sets the centering is removed, thus leaving a reinforced concrete structure in which the reinforcements or core-bars are properly distributed, so as to give the maximum strength to the structure.

In Figs. 7 and 8 I have illustrated the spacing member applied in the building up of main and cross girders. The main girder 9 is shown as provided with rows of reinforcements 10 and 11, located near the bottom thereof. The lower row of reinforcements is held in proper position above the casing 12 and properly spaced one from the other by a spacing member 13. The upper row of reinforcing members 11 is supported by a spacing member 14, laid upon the lowermost row of reinforcing-bars and merely having upward projections 3^b, so as to properly space apart said reinforcing members 11. Near the top of the girder there are also applied several reinforcements 15, which are supported and held apart by a spacing member 16, suitably secured at its ends to the casing 17, or the concrete may first be partly filled in, then the member 18 laid thereon. 18 represents a cross-girder resting partly on top of the main girder 9. This also is provided with a series of reinforcing members 19, which are supported and spaced apart by a member 20, having upturned fingers 3^b for spacing apart the reinforcements 19 and having downturned fingers 3^c bent around one of the core-bars 15. In this manner the spacing member is attached to said core-bar and serves to support and space apart the reinforcements 19 of the cross-girder. Other spacing members 21 support the reinforcements 19 above the centering 22. The concrete in this case is filled into the casing and around the reinforcing and spacing member, and when set the casing and centering is removed. The result is that all of the reinforcements in the main and cross girders are so distributed that the maximum strength is obtained.

In Figs. 9 to 12 I have shown my spacing member applied in the building up of col-

umns or similar structures. The column is provided with vertical strengthening or reinforcing members 23 and with bands 24, which surround the concrete 25, so as to prevent the same from spreading outwardly and fracturing. The spacing-pieces are shown at 26. They have some of their fingers 3^c bent around one of the vertical reinforcements 23 and other of the fingers 3^a projecting outwardly and bearing against the casing 28, so as to hold the vertical members 23 a proper distance away from said casing. The bands 24 are located either between the verticals 23 and body 2 of the spacing member and are thereby prevented from falling down, as shown in Fig. 11, or said bands are held against falling by tongues 29, punched out of the body of the spacing members, as shown in Fig. 12. With the metallic members held in this position the concrete is filled into the casing and around the metallic portions, entirely embedding the same. These metallic portions are held in proper vertical position so that the resultant column has the vertical members properly distributed therein and entirely embedded in the concrete.

The application of the spacing member and clip to column-work, as shown in Figs. 9 to 12, is not claimed herein, but is claimed in my application, filed October 22, 1904, Serial No. 229,635.

Many other applications of my spacing member will suggest themselves to those skilled in the art. In all cases, however, this member serves to properly space the reinforcing members away from the centering or casing, so that said spacing members will be entirely covered by the concrete, and thus not exposed to the air and resultant corrosion, and will also hold said members the requisite distance from the top of the floor, column, or other structure, so as to get the necessary strength. The spacing member also serves to hold the reinforcing members in proper relative positions one to another, so that they will be properly and uniformly distributed in the concrete. The spacing member itself is very simple and can be very cheaply made. It is so constructed that a single size and design of spacing member is adapted for a large variety of uses, in that manner making special dies and designs unnecessary and very greatly reducing the cost of manufacture.

What I claim is—

1. A member for spacing and supporting bars in metal and concrete work, comprising a metal plate having tongues or projections formed on its side edges and separated by interdental spaces, some of its tongues on both edges being bent in one direction and adapted to contact with the centering or casing, and others of said tongues being bent in the opposite direction and serving to space apart reinforcing-bars extending transversely of said member.

2. A member for spacing and supporting bars in metal and concrete work, comprising a sheet-metal strip having tongues or projections formed on its side edges, some of said tongues on both edges being bent in one direction and adapted to contact with the centering or casing, and others of said tongues being bent in another direction and serving to space apart reinforcing-bars extending transversely of said member.

3. A spacing and supporting member for metal and concrete reinforced work, comprising a metal strip having projecting tongues formed on its side edges, said tongues alternating on the two edges, and some on both edges being bent in one direction and others in another direction.

4. In concrete and metal structures, the combination of a member having fingers projecting at an angle to its body and in opposite directions, and metallic members extending transversely of said member held by the fingers projecting in one direction, the fingers projecting in the opposite direction serving to contact with the centering or casing.

5. In concrete and metal structures, the combination of metallic reinforcing members, spacing-pieces comprising metallic strips having projections on the edges, some being bent in one direction to space and support the reinforcing members and others being bent in the opposite direction to contact with the centering or casing, and concrete enveloping and embedding said reinforcing and spacing members.

6. In concrete and metal structures, the combination of metallic reinforcing members, a spacing member comprising a sheet-metal strip provided with projections or tongues on its side edges and arranged alternately, some of said projections being bent in one direction to space apart the reinforcing members and others being bent in the opposite direction to contact with the centering or casing, and concrete or the like enveloping and embedding said reinforcing and spacing members.

7. In metal and concrete structures, the combination of metallic reinforcing members, metallic spacing members having on their side edges fingers or projections, some of which are bent in one direction around one metallic member and others of which are bent in the opposite direction, and concrete or the like enveloping and embedding said reinforcing and spacing members.

8. In metal and concrete structures, the combination of metallic reinforcing members, a spacing member comprising a metal body provided on its edges with projections, some of which are bent in one direction and around a reinforcing member, and others of which are bent in the opposite direction and serve to space apart others of the reinforcing members, and concrete and the like enveloping

and embedding said reinforcing and spacing members.

9. In metal and concrete structures, the combination of metallic reinforcing members, a spacing member comprising a metal body provided on its edges with projections, some of which are bent in one direction and around one of the reinforcing members, and others of which are bent in the opposite direction and serve to space apart others of the reinforcing members, said projections being alternately arranged on the two side edges of said strip and concrete or the like enveloping and embedding said reinforcing and spacing members.

In testimony whereof I, the said ROBERT A. CUMMINGS, have hereunto set my hand.

ROBERT A. CUMMINGS.

Witnesses:
ROBERT C. TOTTEN,
G. C. RAYMOND.

No. 822,587. PATENTED JUNE 5, 1906.

R. A. CUMMINGS.

METAL REINFORCED CONCRETE COLUMN.

APPLICATION FILED JAN. 6, 1905.

FIG. 1

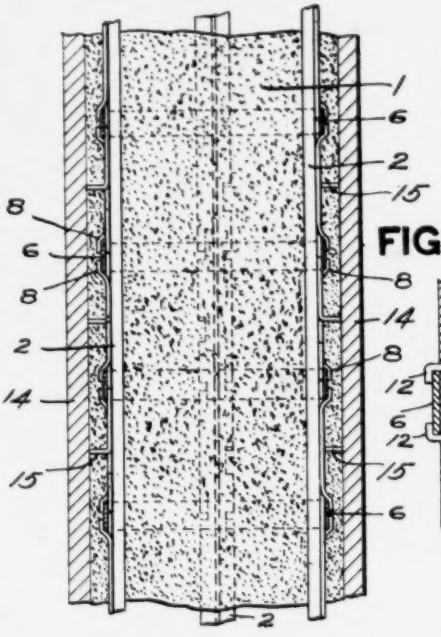


FIG. 2

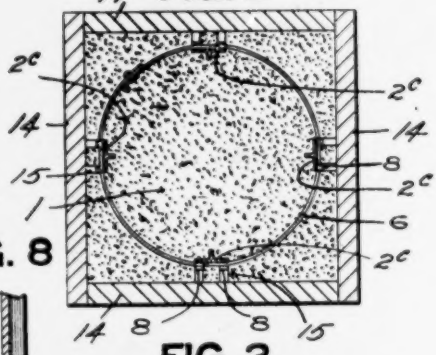


FIG. 8

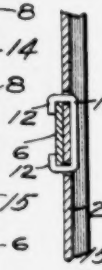


FIG. 3

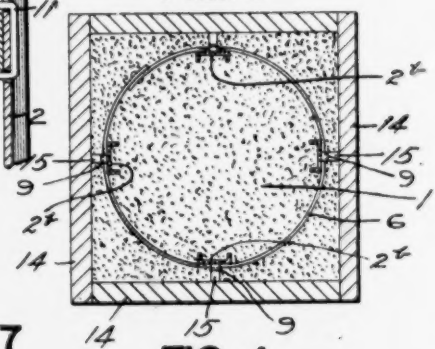


FIG. 5

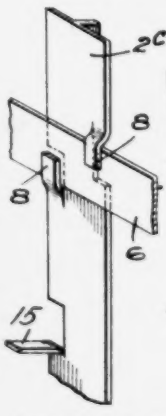


FIG. 6

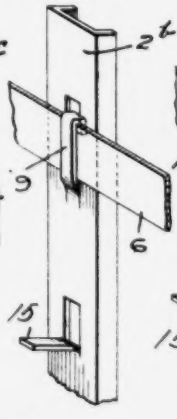


FIG. 7

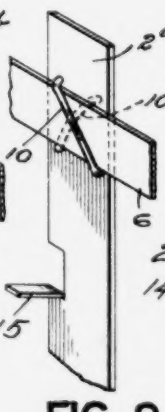


FIG. 4

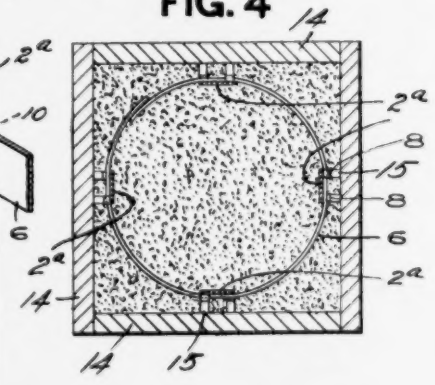
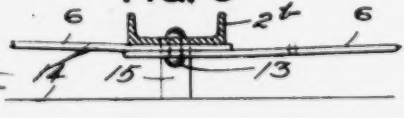


FIG. 9



WITNESSES.

J. R. Keller

Robert C. Totten

INVENTOR.

Robert A. Cummings.

By King Totten & Wende

attorneys

UNITED STATES PATENT OFFICE.

ROBERT A. CUMMINGS, OF BEAVER, PENNSYLVANIA.

METAL-REINFORCED CONCRETE COLUMN.

No. 822,587. Specification of Letters Patent. Patented June 5, 1906.

Application filed January 6, 1905. Serial No. 239,882.

To all whom it may concern:

Be it known that I, ROBERT A. CUMMINGS, a resident of Beaver, in the county of Beaver and State of Pennsylvania, have invented a new and useful Improvement in Metal-Reinforced Concrete Columns; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to concrete cloumns, piles, struts, and the like used in bridges, viaducts, docks, fireproof buildings, and other structures.

The object of my invention is to provide a column or the like which is composed mainly of cement or concrete and which will carry a very heavy load.

Concrete or cement possesses great compressive strength when properly constructed and supported and is also not affected by fire, water, or other elements. For these reasons it is highly desirable in many building constructions. It possesses, however, slight tensile strength, so that when subjected to very heavy loads the concrete will be forced apart laterally, and thus fracture the column.

In my Patent No. 764,883, July 12, 1904, I have described and claimed a column construction wherein the fracturing due to the lateral spreading of the concrete is overcome, this being accomplished by surrounding the main body of the concrete with a series of flat metallic bands which will prevent the concrete from spreading, and consequently from fracturing.

The present invention is an improvement on the column described in my aforesaid patent, one object being to increase the stability of the column by the use of vertical reinforcing members having a cross-section in which the metal is so distributed that the major portion thereof will be as far removed as possible from the center of the column, thus increasing the radius of gyration.

A further object of the invention is to provide means on the vertical members, whether of the character above described or otherwise, for holding them properly spaced from the casing, so that said members will be uniformly distributed in the concrete and be entirely embedded therein.

A further object is to provide improved means for holding the transverse bands against either downward or upward movement.

To these ends the invention consists in details of construction and arrangement hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a vertical section through a column constructed according to my invention. Fig. 2 is a transverse section thereof. Figs. 3 and 4 are similar views showing modifications. Figs. 5, 6, and 7 are perspective views showing different manners for holding the bands against movement. Fig. 8 is a vertical section of another modification, and Fig. 9 is a horizontal detail section of still another modification.

In the drawings the concrete is shown at 1, and the vertical reinforcing members at 2. The latter may be variously arranged and located, depending upon the size and shape of the column. They will be of a cross-section, having the metal so distributed that the major portion thereof will be as far out from the center of the column as possible, so as to get the greatest radius of gyration and correspondingly increasing the stability of the column. The most advantageous cross-section to secure this result is a flat rectangular bar, strip, or band, such as shown at 2^a, Fig. 4. Preferably, however, these reinforcing members will be slightly stiffened by providing them with one or more inwardly-projecting flanges, either by using a channel-section, as shown at 2^b, Fig. 3, or a modified angle or T-section, the latter being shown at 2^c, Figs. 1 and 2. The inwardly-projecting flange or flanges of the angle, channel, or T sections greatly stiffen these reinforcing members. The metal nevertheless is so distributed that the major portion thereof is in the web of the channel or in the head of the T-bar, and as these are directed outwardly the radius of gyration is correspondingly large. In my design these vertical members are not intended to act as compression members, although they probably do so to some extent, but they act as tension members to prevent the flexing of the column. They also serve as means for supporting bands 6, which extend transversely of the column and envelop the major portion of the concrete body, these bands serving to hold the concrete against fracturing laterally, and thereby developing the greatest compressive strength of said concrete. The bands 6 therefore will preferably be flat and arranged with their flat

faces vertical; but they may be of other cross-section. They will be located comparatively closely together, so as to confine the major portion of the body of the concrete. These bands will have their ends united to form continuous bands in any suitable way, either in the manner shown in my patent aforesaid, or as illustrated in my application filed October 22, 1904, Serial No. 229,635, or by riveting the ends of the bands together, as shown in the drawings, or any other suitable way. One feature of the present invention consists in the manner of securing these bands to the vertical members, so as to prevent their movement vertically. Preferably this connection will be so arranged that the bands can neither rise nor fall, thus preventing them from becoming spaced apart irregularly or from assuming a diagonal position.

As shown in Figs. 1, 2, and 5, the vertical members have punched out from their opposite edges the tongues 8, which are arranged diagonally and engage the two edges of the bands and hold the same securely in place and against either falling or rising. The diagonal arrangement of these tongues provides for the easy insertion of both edges of the bands underneath said tongues.

In Fig. 6 there is only one tongue 19, whose upper end is bent across the top of the band to hold it from rising.

In Fig. 7 the bands are shown held in place by means of a staple 10 or the like, embracing the band and having its ends projecting through openings in the vertical member and upset or bent on the back. If desired, two such staples may be used, as indicated in the dotted lines.

In Fig. 8 the staple 11 is located on the rear of the vertical member and has its ends 12 projecting through openings in the vertical members and bent over the front face of the band.

In Fig. 9 a simple rivet 13 is shown for securing the band to the vertical member. This rivet may be one of the rivets which secures the ends of the band together.

Another feature of the invention consists in means for holding the vertical reinforcing members a proper distance away from the casing 14, so that said members will be uniformly distributed and entirely embedded in the concrete. The means for so holding these vertical members consists of projecting portions 15 on the vertical members themselves, which contact with the casing. These projecting portions preferably will be portions punched out of the reinforcing members and bent at an angle thereto to contact with the casing.

The metallic members of the column will be built up in the manner described and then inclosed in the casing and the concrete and cement filled into the same, thus entirely enveloping and embedding the metallic members. The bands 6 envelop the major portion of the body of the concrete, thus holding the same against lateral fracture, and consequently enabling the same to carry very heavy loads. The vertical reinforcing members act as tension members to resist flexing of the column. These vertical members have the major portion of their metal removed the greatest possible distance from the center of the column, thus greatly increasing the radius of gyration and giving the maximum stability to the column for the amount of metal in the vertical members. The bands are connected to the vertical members in such a manner that they will be held absolutely in place even though the workmen should use the bands as a ladder to climb up and down, as they frequently do in constructing the columns. Said bands in the completed column will be in a true horizontal position, thus giving them the maximum efficiency. The entire metallic structure will be uniformly distributed in the concrete by reason of the projecting portions 15, which contact with the casing. The resultant column possesses a very high degree of strength.

What I claim is—

1. A column or the like, comprising a series of metallic members extending vertically of the column, a series of metallic bands running transversely thereof and enveloping the main body of concrete, projections on said vertical members for holding the bands fixedly in place transversely to the axis of the column, and concrete or the like enveloping and embedding said bands and vertical members.

2. A column or the like, comprising a series of metallic members extending vertically of the column, a series of metallic bands running transversely thereof and enveloping the main body of concrete, said vertical members having projecting portions engaging the bands and holding the same fixedly in place transversely to the axis of the column, and concrete or the like enveloping and embedding said bands.

3. A column or the like, comprising a series of metallic members extending vertically of the column, a series of bands running transversely thereof and enveloping the main body of concrete, said vertical members having openings punched in their bodies, means projecting through said openings engaging said bands and holding the same fixedly in place transversely to the axis of the column, and concrete or the like enveloping and embedding said bands.

4. A column or the like, comprising a series of metallic members extending vertically of the column, a series of metallic bands running transversely thereof and enveloping the main body of concrete, staples having their ends projecting through openings in said ver-

tical members, said staples engaging said bands and holding the same fixedly in place transversely to the axis of the column, and concrete or the like enveloping and embedding said bands and vertical members.

5. A column or the like, comprising a series of metallic members extending vertically of the column, a series of metallic bands running transversely thereof and enveloping the main body of concrete, staples having their ends projecting through openings in said vertical members and bent over the front face of said bands and holding the same fixedly in place transversely to the axis of the column, and concrete or the like enveloping and embedding said bands and vertical members.

6. A column or the like comprising a series of metallic members extending longitudinally of the column, said members being provided with broad thin webs and arranged with said webs toward the outer face of the column, a series of bands connected to said vertical members and extending transversely of the column and enveloping the main body of concrete, and concrete or the like enveloping and embedding said metallic members.

7. A column or the like, comprising a series of matallic members extending longitudinally of the column, said members being provided with broad webs arranged toward the outer face of the column and with an inwardly-projecting flange or flanges, a series of metallic bands extending transversely of the column and connected to said vertical members and enveloping the main body of concrete, and concrete or the like enveloping and embedding said metallic members.

8. A column or the like, comprising a series of metallic members extending longitudinally of the column, said members having the major portion of the metal on the sides facing the outer surface of the column and being provided with projecting portions for contacting with the casing, and concrete or the like enveloping and embedding said metallic members.

9. A column or the like, comprising a series of vertical metallic members provided with projecting portions for contacting with the casing, a series of bands extending transversely of the column and engaging said vertical members, and concrete or the like enveloping and embedding said metallic members.

10. A column or the like, comprising a series of metallic members extending longitudinally of the column and having portions thereof punched out and bent at an angle to contact with the casing, and concrete or the like enveloping and embedding said metallic members.

11. A column or the like, comprising a series of metallic members extending longitudinally of the column and having portions of their bodies punched out and bent at an angle to contact with the casing, a series of bands extending transversely of the columns and engaging said longitudinal members, and concrete or the like enveloping and embedding said metallic members.

In testimony whereof I, the said ROBERT A. CUMMINGS, have hereunto set my hand.

ROBERT A. CUMMINGS.

Witnesses:
F. W. WINTER,
ROBERT C. TOTTEN.

R. A. CUMMINGS.

CONCRETE COLUMN AND THE LIKE.

APPLICATION FILED OCT. 22, 1904.

FIG. 1

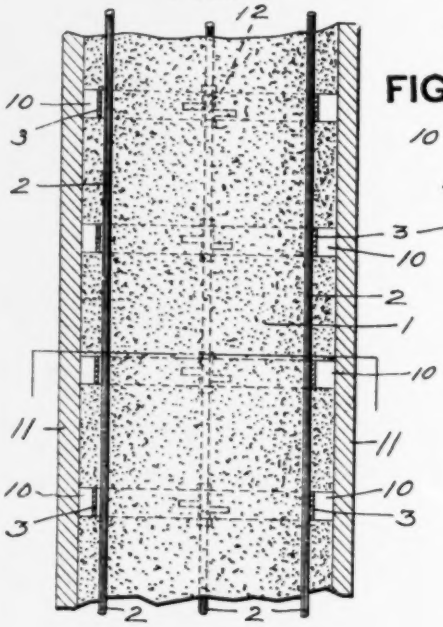


FIG. 2

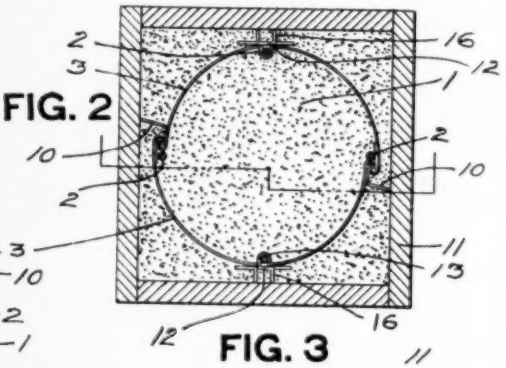


FIG. 3

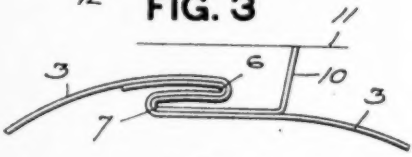


FIG. 4

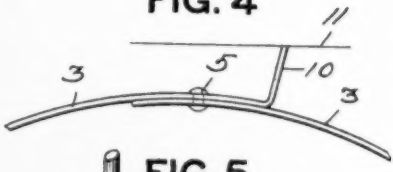


FIG. 8

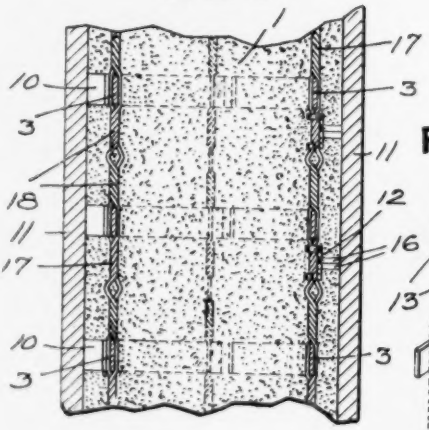


FIG. 5

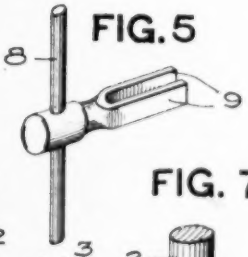


FIG. 6

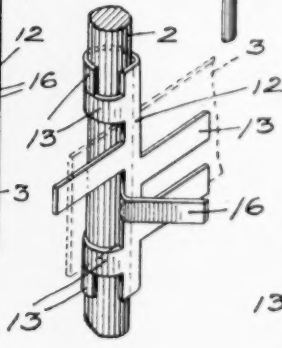
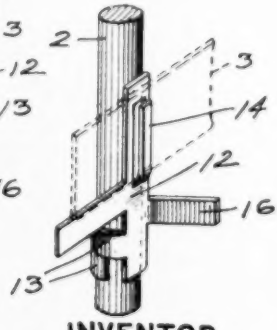


FIG. 7



WITNESSES.

J. R. Keller

Robt C Totten

INVENTOR.

Robert A Cummings

By Kay Totten & Winter

attorneys

UNITED STATES PATENT OFFICE.

ROBERT A. CUMMINGS, OF BEAVER, PENNSYLVANIA.

CONCRETE COLUMN AND THE LIKE.

No. 828,931. Specification of Letters Patent. Patented Aug. 21, 1906.

Application filed October 22, 1904. Serial No. 229,635.

To all whom it may concern:

Be it known that I, ROBERT A. CUMMINGS, a resident of Beaver, in the county of Beaver and State of Pennsylvania, have invented a new and useful Improvement in Concrete Columns and the Like; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to concrete columns, piles, struts, and the like used in bridges, viaducts, docks, fireproof buildings, and other structures.

The object of my invention is to provide a column, pile, or strut which is composed mainly of cement or concrete and which will carry a very heavy load.

Concrete or cement possesses great compressive strength when properly constructed and supported, and it is not affected by fire, water, or other elements. For these reasons it is highly desirable in many building constructions. It possesses, however, slight tensile strength, so that when subjected to very heavy loads the concrete will be forced apart laterally, and thus fracture the column.

In my Patent No. 764,883, July 12, 1904, I have described a column construction wherein the fracturing due to the lateral spreading of the concrete is overcome, this being accomplished by surrounding the main body of the concrete with a series of flat metallic bands, which will prevent the concrete from spreading, and consequently from fracturing.

The present invention is an improvement on the column described in my aforesaid patent, the object being to simplify the construction of the bands and also of the longitudinal rods and to provide improved means which can be applied at the place of building the column for uniting the ends of the strips to form a continuous band and to hold the metallic parts in proper position with reference to the casing and also to provide means for holding the bands from falling down.

To these ends the invention consists in details of construction and arrangement hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a vertical section through a column constructed according to my invention. Fig. 2 is a horizontal section therethrough. Fig. 3 shows the preferred manner of uniting the ends of the strips to form continuous bands. Fig. 4 shows a modification thereof. Fig. 5 is a view of a suitable tool for forming the joint shown in Fig. 3. Fig. 6 is a perspective view of the clip for holding the bands from falling down. Fig. 7 is a similar view showing a modification, and Fig. 8 is a vertical section showing a modified form of column.

In the drawings the concrete is shown at 1 and the vertical rods or reinforcing members at 2. The latter may be of various forms, either round or flat, and may be variously located, depending upon the size and shape of the column. In Fig. 2 four rods are shown located substantially ninety degrees apart and near the side faces of the column, but so that they are entirely embedded or enveloped by the concrete, and thus protected from the elements.

At suitable intervals in the column are embedded strips or bands 3 of metal of suitable size and width, so as to prevent the concrete from spreading laterally. These strips have their ends connected, so as to form continuous bands which encircle the main body of the concrete composing the column. Each band may be composed of a single continuous strip having its two ends united, or each band may be made up of a plurality of strips having their meeting ends united, and thus forming the continuous band. In the drawings I have shown each band composed of two strips with the ends thereof united; but I wish it understood that I do not exclude a construction wherein the band is made of a single or of more than two united strips. The ends of these bands will be united in any suitable way—such, for instance, as by means of the rivets 5, (shown in Fig. 4,) but preferably by having the ends overlapped and then bent into reverse curved form, such as shown in Fig. 3, so as to form, in effect, two hooks 6 and 7. This bending of the strips can be conveniently accomplished at the place of building the column by means of a suitable tool, such as shown in Fig. 5, the same having a handle 8 and a pair of fingers or prongs 9, between which the overlapped strips will be placed, and then by giving said tool a half-turn the strips will be bent into the reflex form shown in Fig. 3, thus forming a secure and tight interlocking connection. This joint may be hammered flat, if desired. The extreme end of the outermost lap will in all cases be bent outwardly, as at 10, thus forming a spacing-piece for contacting with the mold or casing 11 and holding the metal portions a proper distance away from said casing,

so that the concrete when filled around the same will thoroughly conceal and embed all portions of the metallic structure.

The bands 3 encircle the longitudinal rods or members 2 and preferably are of general circular form, as shown in Fig. 2. When only a single longitudinal rod 2 is provided at each place, as in Figs. 1 and 2, means is provided to keep the bands from falling down and to hold the same in place until the concrete is built around the same. For this purpose I use suitable clips for attaching the same to the rods. These clips may be of various forms; but I prefer to use a sheet-metal member having a body 12 with tongues or fingers projecting from the two edges thereof. Some of these tongues or fingers 13 will be bent around the longitudinal members 2, as shown in Figs. 6 and 7, to secure the clips firmly to said members. The bands 3 will either be inserted between the body of the clip 12 and rod 2, as shown in Fig. 6, and will be prevented by the encircling fingers 13 from dropping down or else the band will be held up by means of a tongue 14, stamped out from the body of the clip, as shown in Fig. 7, or by a combination of both. Others of the lateral-projecting fingers of the clips will be turned outwardly, as shown at 16, so as to contact with the casing or mold 11 and hold the metallic members a proper distance away therefrom. These clips need not be used on all of the longitudinal bars unless so desired, and if used on the longitudinal bars at the points where the ends of the bands meet and where the bands have the outwardly-turned fingers 10 then the fingers 16 on the clips need not be turned outwardly to contact with the casing; but at other points where there is no outturned end on the band these clips will have some of their fingers turned outwardly to serve as the spacing members to contact with the casing.

In Fig. 8 is shown a modification wherein the bands 3 are held between two rods 17, one inside the bands and the other outside the same, said rods being twisted together intermediate the adjacent bands, as at 18, as may be conveniently done by inserting a bar between said rods and turning the same. In this modification the clips 12 can be dispensed with except at places where the fingers 16 are necessary to hold the longitudinal members away from the casing.

After the metal structure has been built up in the manner specified the concrete will be filled into the casing and around the metal members, entirely enveloping and embedding the longitudinal rods, the bands, and the clips. The projecting ends 10 of the bands, together with the projecting fingers 16 of the clips, hold the metallic parts in proper position relative to the casing, and the clips 12 or twisted rods of Fig. 8 hold the bands from sliding down. As a result the column has the metallic members uniformly and properly distributed in the concrete, and all portions of the metallic parts are completely enveloped by the concrete, so that said metallic parts cannot be affected by the elements.

The column described is exceedingly strong, this resulting in part from the uniform distribution of the metallic members therein, but mostly from the fact that the bands prevent the concrete from spreading laterally, and thus fracturing. The bands can be ordinary sheet-metal bands of the desired width and of any desired lengths. Indeed, odd lengths can be used at the place of construction by merely bending their ends to form the interlocking joint shown in Fig. 3. The clips are thin sheet-metal members stamped into form with the projecting fingers on their edges. These fingers can be easily bent at the place of construction, so as to attach the clips to the longitudinal rods and to space the metallic structure from the casing. The bands and clips are cheap and easy of application.

What I claim is—

1. A column, pile or the like, comprising a series of metallic strips or bands running transversely of the column and having their ends united to form continuous bands and having an extreme end portion bent outwardly to form a spacing member for contacting with the mold or casing, and concrete or the like enveloping and embedding said bands.

2. A column, pile or the like, comprising a series of rods or strips extending longitudinally of the column, a series of metallic strips or bands running transversely of the column and having their ends united to form continuous bands and having extreme end portions bent outwardly to form spacing members for contacting with the mold or casing, and concrete or the like enveloping and embedding said bands and rods.

3. A column, pile or the like, comprising a series of metallic strips provided with interlocking end portions and united thereby to form continuous bands running transversely of the column and having extreme end portions bent outwardly to form a spacing member for contacting with the mold or casing, and concrete or the like enveloping and embedding said bands.

4. A column, pile or the like, comprising a series of rods or strips extending longitudinally of the column, a series of metallic strips provided with interlocking end portions and united thereby to form continuous bands and running transversely of the column and having extreme end portions bent outwardly to form spacing members for contacting with the mold or casing, and concrete or the like enveloping and embedding said bands and rods.

5. A column, pile or the like, comprising a series of metallic strips having their ends bent

into hooks and united thereby to form continuous bands and running transversely of the column, and concrete or the like enveloping and embedding said bands.

6. A column, pile or the like, comprising a series of metallic strips having their ends bent into hooks and united thereby to form continuous bands and having portions bent outwardly to form spacing members for contacting with the mold or casing, and concrete or the like enveloping and embedding said bands.

7. A column, pile or the like, comprising a series of flat metallic strips having their ends lapped and bent into reverse curves to form double hooks and united thereby to form continuous bands, and concrete or the like embedding and enveloping said bands.

8. A column, pile or the like, comprising a series of flat metallic strips having their ends lapped and bent into reverse curves to form double hooks and united thereby to form continuous bands and having the extreme end of the outer lap bent outwardly to form a spacing member for contacting with the mold or casing, and concrete or the like enveloping and embedding said bands.

9. A column, pile or the like, comprising a series of rods extending longitudinally of the column, a series of bands running transversely of the column, clips for securing the bands to the rods, said clips having portions projecting outwardly to contact with the mold or casing, and concrete or the like embedding and enveloping said bands and rods.

10. A column, pile or the like, comprising a series of rods extending longitudinally of the column, a series of bands running transversely of the column, clips comprising metallic members provided with projecting fingers some of which are bent in one direction around the rods and others of which are bent outwardly to contact with the casing or mold, and concrete or the like enveloping and embedding said rods and bands.

11. A column, pile or the like, comprising a series of rods extending longitudinally of the column, a series of bands running transversely of the column, clips comprising metallic members provided with projecting fingers some of which are bent in one direction around the rods and others of which are bent outwardly to contact with the casing or mold, said clips having means for engaging the bands, and concrete or the like enveloping and embedding said rods and bands.

In testimony whereof I, the said ROBERT A. CUMMINGS, have hereunto set my hand.

ROBERT A. CUMMINGS.

Witnesses:

ROBERT C. TOTTEN,

G. C. RAYMOND.

No. 857,821. PATENTED JUNE 25, 1907.

E. McCLURE.

BUILDING CONSTRUCTION.

APPLICATION FILED DEC. 17, 1906.

Fig. 1.

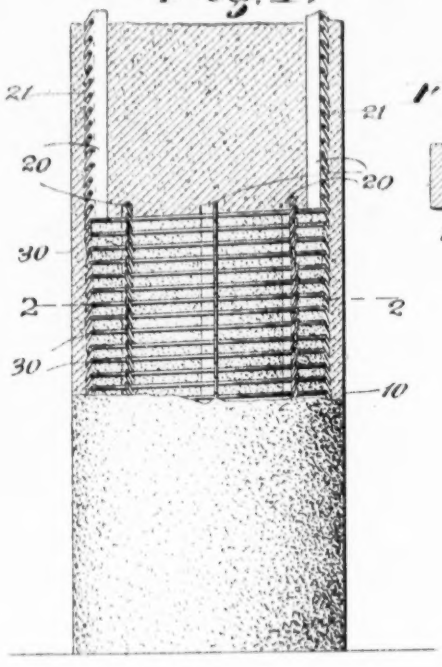


Fig. 4.

Fig. 3.

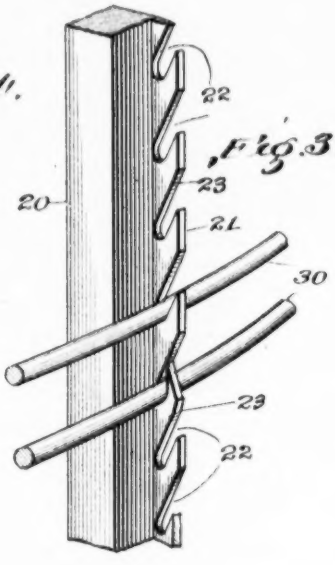


Fig. 5.

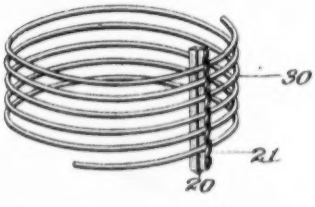


Fig. 2.

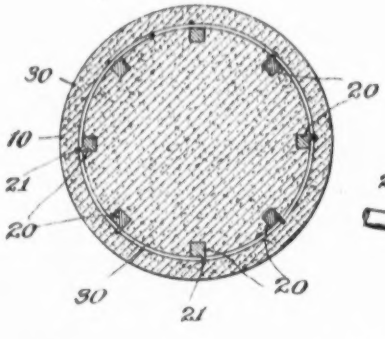


Fig. 8.

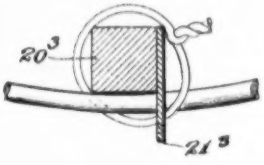


Fig. 6.

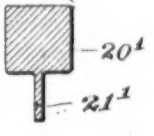


Fig. 7.

Witnesses:
Wm. P. Bond
Leone S. Russell

Inventor:
Edward McClure,
by Charles C. Shervey
his Atty.

UNITED STATES PATENT OFFICE

EDWARD McCLURE, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO FRANKLIN P. SMITH, OF CHICAGO, ILLINOIS.

BUILDING CONSTRUCTION.

No. 857,821. Specification of Letters Patent. Patented June 25, 1907.

Application filed December 17, 1906. Serial No. 348,119.

To all whom it may concern:

Be it known that I, EDWARD McCLURE, a citizen of the United States, a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Building Construction, of which the following is a full, clear, and exact description.

My invention relates to certain new and useful improvements in building construction and more particularly to improvements in the columns which form the upright supporting members, of the building.

The object of the invention is to simplify constructions of this class, to increase the strength thereof, to provide a rigid and practically inflexible binder for the concrete and to otherwise improve the same.

To such end the invention relates to certain novel features of construction and arrangement, a description of which will be found in the following specification and the essential features of which will be more definitely pointed out in the appended claims.

The invention is clearly illustrated in the accompanying drawing in which

Figure 1 is a view partly in side elevation and partly in section illustrating the preferred form of my invention. Fig. 2 is a horizontal section taken in the line 2—2 Fig. 1. Fig. 3 is a fragmental perspective view of one of the upright members, and binder wire that form the main frame or skeleton of the column. Fig. 4 is a horizontal cross section through one of the uprights. Fig. 5 is a perspective view of a fragment of the binder wire and one upright, and Figs. 6, 7 and 8 are horizontal cross sections of modified forms of uprights.

In Figs. 1 to 5, inclusive, 10 represents a column constructed in accordance with the preferred form of my invention. As shown the frame work of the column contains a number of circumferentially disposed bars or uprights 20, of any suitable cross section, and preferably of rolled steel bars. The size of the bars, that is to say the area of their cross section, and their number depend upon the size of the column and the load to be carried, and the ones shown in Figs. 3 and 4 are approximately half size and suitable for a column of say, from 18 to 30 inches. These bars are connected by a coil of wire 30, which is wound around the bars and suitably spaced apart and connected thereto by a serrated or toothed fin or web 21, which extends out from the main part of the bar or rod as clearly shown in Figs. 3 and 4. This fin or web 21, is quite thin as compared with the main body of the bar or rod 20, and the notches or spaces 22, between the teeth 23 preferably extend at an acute angle with respect to the bar or rod. The alternate bars or rods 20, are upended or reversed, to make the teeth and notches extend downward and in a direction opposite to that in which the notches in the other bars extend, the effect being to secure the wire to the bars or rods without any further fastening medium. In practice, however, it is found desirable to clench the ends of some of the teeth down upon the wire and this is done with every fifth or sixth tooth. By thus clenching a few of the teeth the wires and uprights are tied together and no twisting is possible of the frame thus formed. In constructing columns of this class it is important that the main body of the uprights should not be weakened in any manner, inasmuch as its strength will thereby be greatly impaired. Various attempts have been made to space the wires upon the uprights and to tie them thereto, as for instance, they have been wired thereto, but with a construction of this kind the frame when complete, may be twisted around and it is practically impossible to make a perfectly rigid frame, which is obviously necessary in a device of this class. For very light work, thin, notched strips have been used but this is impractical for heavy work, and if rods of large diameter are used with notches and teeth extending the full width of their faces, a great waste of material is occasioned and the bar is weakened by punching out the slots between the teeth. Furthermore the clenching down of teeth of this size becomes a difficult matter requiring extra labor and time. By constructing the rod or bar of the proper cross section to be the most effective for the purpose intended, and providing it with a serrated fin or web for the attachment of the wire, all of the undesirable and impracticable features are avoided and means are provided whereby the rods and wire may be firmly united to make a more rigid frame work, with less amount of metal, and labor in its construction. To complete the column the frame thus formed is filled with concrete 30

and the outer surface covered with two or three inches of concrete, thus completely embedding the frame in the concrete. The concrete surrounds the bars on all of their sides and fills in between the teeth of the fins and between the turns of the coil of wire, so that the frame and concrete are firmly united. A column thus constructed has practically the same carrying capacity as the ordinary steel column occupying the same amount of area in cross section and is less destructible in fire than the unprotected steel columns.

In Fig. 6 the fin or web 21^1 is shown as placed in the center of one of the sides of the bar 20^1, and in Fig. 7 the bar 20^2 is oblong in cross section with the fin or web 21^2 extending out from one of its corners. In Fig. 8 the fin or web is shown as composed of a separate strip of metal 21^3 wired to the main bar 20^3. Other alterations and modifications of the device are possible and I do not therefore desire to limit myself to the specific forms shown and described except as particularly pointed out in the appended claims.

I claim as new and desire to secure by Letters Patent.

1. In a concrete column construction, the combination of one or more upright bars or rods and a spiral encircling band extending throughout the entire length of the column, each bar or rod having a thin toothed longitudinally extending web adapted to form a connecting medium between the encircling band and the bars or rods.

2. In a concrete column construction, the combination of a plurality of circumferentially disposed upright bars or rods, each having a thin toothed longitudinally extending fin or web, a spiral coil of wire wound upon the bars and extending throughout the entire length of the column, each turn of the wire being seated in the notches between the teeth of the fins, and a body of concrete in which the bars and wire are wholly embedded.

3. In a concrete column construction, the combination with a metal frame work, comprising upright bars or rods having thin longitudinally extending fins or webs that contain diagonally extending notches, and a spiral coil of wire wound upon said bars and extending throughout the entire length of the column, each turn of said wire resting in a notch in the fins or webs, of a body of concrete in which the frame work is wholly embedded.

4. In a concrete column construction, the combination of a plurality of upright bars or rods, each having a thin longitudinally extending toothed fin or web, the teeth extending diagonally with respect to the bar, and the teeth on the alternate bars extending upward, and on the others extending downward, a spiral coil of wire wound around the bars or rods and extending throughout the entire length of the column and seated in the spaces between the teeth, and a body of concrete in which the bars and wire are wholly embedded.

5. In a concrete column construction, the combination of a plurality of bars or rods, each having a longitudinally extending toothed web, a spiral coil of wire wound around the bars or rods and extending throughout the entire length of the column and seated in the spaces between the teeth, certain of which are clenched down upon the wire, and a body of concrete in which the bars and wire are wholly embedded.

In witness whereof I have executed the above application for Letters Patent of the United States, at Chicago, county of Cook and State of Illinois, this twelfth day of December, 1906.

EDWARD McCLURE.

Witnesses:
R. R. BARNITT,
A. FRISBIE.

290

D. A. WEDMORE.

METALLIC REINFORCE FOR CONCRETE CONSTRUCTION.

APPLICATION FILED MAY 4, 1908.

918,715. Patented Apr. 20, 1909

Fig. 1.

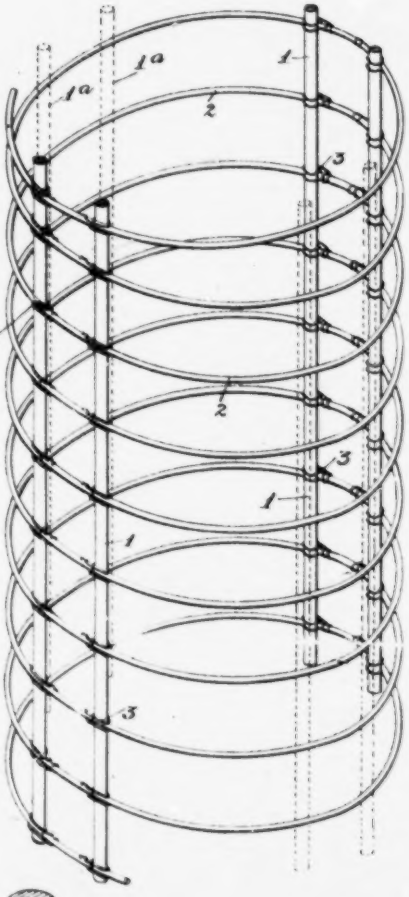


Fig. 2.

Fig. 7.

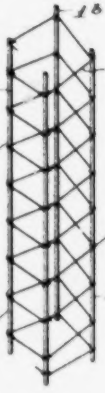


Fig. 6.

Fig. 3.

Fig. 4.

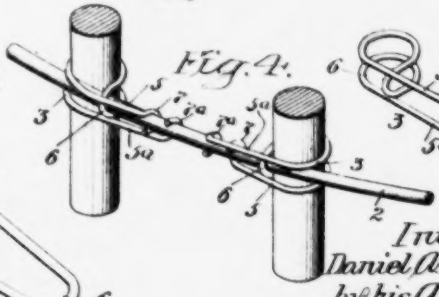


Fig. 5.

Witnesses:
Walter J. Dillinger
Wallace A. Burrows

Inventor:
Daniel A. Wedmore
by his Attorneys
Wesson & Wesson

UNITED STATES PATENT OFFICE.

DANIEL A. WEDMORE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO PHILADELPHIA STEEL & WIRE CO., OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

METALLIC REINFORCE FOR CONCRETE CONSTRUCTION.

No. 918,715. Specification of Letters Patent. Patented April 20, 1909.

Application filed May 4, 1908. Serial No. 430,834.

To all whom it may concern:

Be it known that I, DANIEL A. WEDMORE, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Metallic Reinforces for Concrete Construction, of which the following is a specification.

My invention relates to concrete construction in which metallic reinforcing means are employed; and the object of my invention is to provide a collapsible reinforce for column construction, capable of being assembled in a shop or factory for shipment to the job in a folded or collapsed condition and available to be set up in the position of use and, with the aid of the usual form or centering, receive the concrete and thus form the core and support of the complete column.

My invention is fully shown in the accompanying drawings, in which:

Figure 1, is a perspective view of collapsible reinforcing means for column construction showing the same set up, preparatory to placing the centering for receiving the concrete; the additional rods which are provided for the complete structure being indicated in dotted lines; Fig. 2, is a view of the reinforcement in the collapsed condition; Fig. 3, is a perspective view, full size, of the tie member prior to use; Fig. 4, is an enlarged perspective view of a pair of the vertical rods and the helical spacer for the same, showing the manner of securing the rods and spacer together; Fig. 5, is a perspective view of the tie member as bent in securing the parts together; Fig. 6, is a sectional plan view of the column reinforce, and Fig. 7, illustrates a form of structure rectangular in contour.

The present practice of reinforcing concrete structures is, of course, too well known to require explanation or detailed description. The common method of procedure in the reinforcing of posts or columns is to either build the reinforcing element on the job or to have the structure rigidly built in its final form and shipped to the place of use, there to receive the heavier reinforcing bars, or, in some instances carrying the same with them. In the use of reinforcing structures of this character, there are a number of difficulties, among which may be mentioned the excessive freight incident to the shipment of heavy structures, the built of the ready built structure, and in the case of the reinforcements erected on the job the time that must be consumed in fitting the elements of the same together. All of these objections are avoided by the use of the folding or collapsible structure forming the subject of my invention.

My present invention is directed particularly to reinforced columns. In a pending application I have illustrated one form of column substantially square and providing for the construction of a square column, made up of corner bars with independent horizontally disposed spacing members. My present invention, however, comprises a reinforcement consisting of a series of vertical reinforcing rods with a continuous spacing member of heavy wire or flat metal extending from the bottom to the top of the column and tied at intervals to pairs of oppositely disposed reinforcing bars. By disposing these bars in pairs relatively close together and providing a special form of tie member for securing them to the helical spacer, I provide a structure that can be readily collapsed as indicated in Fig. 2; the tie members forming hinge joints between said spacer and the vertical reinforcing rods.

In the drawings 1, 1, represent the reinforcing rods; 2, the helical spacer, and 3, the tie members connecting said spacer and rods. Although each hinge joint formed by the tying to ans is on the arc of a circle described by the helical spacer, yet such securing means are disposed so close together that in practice no difficulty is experienced in attempting to fold the structure on the joint thus formed.

The enlarged view, Fig. 3, shows the tying member before use, and Fig. 4, shows the manner of connecting the vertical reinforcing rods and the helical spacer by the use of the same. As shown in Fig. 3, this tying device has substantially paralleling runs 5 and 5^a connected by a bend 6 forming a continuous structure; said runs having at their free ends hooks 7 and 7^a which may lie in the same plane or at an angle to each other. This tie member is first applied to the helical spacing band or wire; the bend 6 of the same engaging it in the manner shown in Fig. 4; such bend being held close to the vertical reinforcing rod by a suitable tool, while the hooked portions of the substantially paral-

leling runs are caught around the wire forming the spacing means; one of said ends being shorter than the other. It will thus be seen that a hinge joint is provided by the tying means that will permit folding or collapsing of the structure to permit of its ready handling. When set upon the job, additional pairs of bars or rods such as indicated at 1^a in dotted lines are employed in connection with the structure and these may be secured to the helical wire or band forming the spacing means at various points. It is, of course, unnecessary to tie these additional bars at every run of the spacer, since the main bars employed in connection with the same when in its collapsible condition, are tied at every run, and such condition will insure the proper positioning of the spacing means.

In the form of structure shown in Fig. 7, the vertical rods or bars 1^b are disposed singly, in rectangular form, with a continuous spacer 2^a, the whole being capable of folding or collapsing in substantially the same manner as the structure shown in Fig. 1.

It is obvious, of course, that other forms of ties capable of performing the function desired may be employed instead of the specific device shown and described herewith, and hence my invention is not limited to the use of any specific form of tying means for securing the rods and spacer together.

I claim:

1. A collapsible reinforcement for concrete construction, comprising a series of longitudinal reinforcing bars or rods, a continuous spacing member connected to said rods, and means permitting movement of said members with respect to each other and securing the same together, said reinforcing bars or rods being disposed in pairs opposite each other and the rods of each pair being relatively close together.

2. A collapsible reinforcement for concrete construction, comprising pairs of longitudinal reinforcing bars or rods, a continuous spacing member connected to said rods, and tying means forming hinge joints connecting said rods and spacing member, said pairs of rods being disposed opposite each other and relatively close together.

3. A collapsible reinforcement for concrete column construction, comprising pairs of longitudinal reinforcing bars or rods, a continuous spacing member connected to said rods, and tying means encircling the rods and secured to the spacing member, said means connecting said bars and spacing member together but permitting movement of the same with respect to each other, said reinforcing bars or rods being disposed in pairs opposite each other and the rods of each pair being relatively close together.

4. The combination, in a reinforcement for concrete construction, of a series of longitudinal reinforcing rods or bars, a helically coiled wire forming spacing means for said bars, and tying means at the crossing points of said wire and bars, said means being so disposed as to form hinge joints permitting movement of said bars and wire with respect to each other to collapse the structure.

5. The combination, in a reinforcement for concrete column construction, of pairs of longitudinal reinforcing rods or bars, a helically coiled wire forming spacing means for said bars, and tying means at the crossing points of said wire and bars, said means being so disposed as to form horizontal hinge joints permitting movement of said bars and wire with respect to each other to collapse the structure.

6. The combination, in a reinforcement for concrete construction, of reinforcing rods or bars, a helically coiled spacing member, and tying means connecting said spacing member and the rods or bars, said tying means comprising a looped member having substantially paralleling runs with hooked ends, the loop of said member being adapted to engage the continuous spacing member while the hooked ends of the tie are arranged to pass around the rods or bars and engage the spacing members at points beyond the loop.

7. The combination, in a reinforcement for concrete column construction, of reinforcing rods or bars, a helically coiled spacing member, and tying means connecting said spacing member and the rods or bars, said tying means comprising a looped member having substantially paralleling runs with ends of unequal length terminating in hooks, the loop of said member being adapted to engage the continuous spacing member while the hooked ends of the tie are arranged to pass around the rod or bars and engage the spacing member at different points beyond the loop.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

DANIEL A. WEDMORE.

Witnesses:
E. P. WALLACE,
G. REDMOND.

E. McCLURE.

CONCRETE REINFORCEMENT.

APPLICATION FILED AUG. 8, 1910.

992,970. Patented May 23, 1911.

Fig. 1.

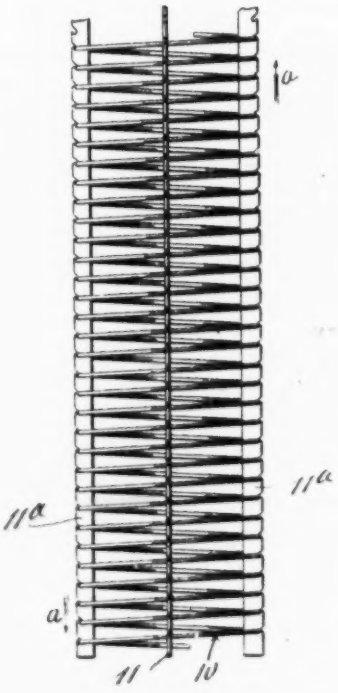


Fig. 5.

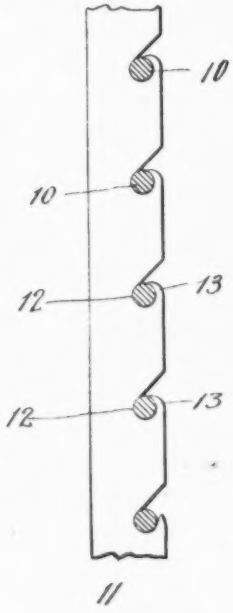


Fig. 3.

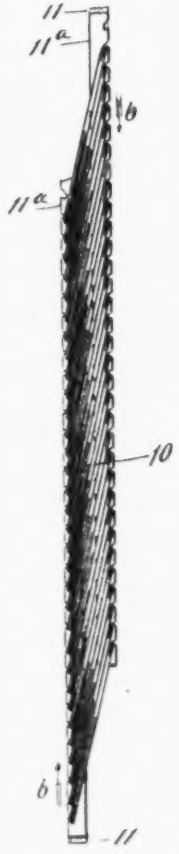


Fig. 2.

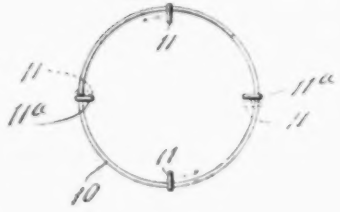
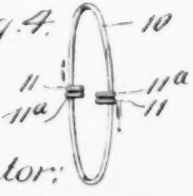


Fig. 4.



Witnesses:
Fannie F. Richards
Rebecca Rhoads-Billings

Inventor:
Edward McClure
by Charles J. Sherry
his Atty

UNITED STATES PATENT OFFICE.

EDWARD McCLURE, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO FRANKLIN P. SMITH, OF CHICAGO, ILLINOIS.

CONCRETE REINFORCEMENT.

992,970. Specification of Letters Patent. Patented May 23, 1911.

Application filed August 8, 1910. Serial No. 576,088.

To all whom it may concern:

Be it known that I, EDWARD McCLURE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Concrete Reinforcements, of which the following is a specification.

This invention relates to concrete reinforcements and more particularly to that class of reinforcements used in reinforced concrete columns for resisting the lateral or transverse stresses that occur therein.

The object of this invention is to provide a reinforcement unit of this class which may be collapsed into condensed form for transportation or storage, and which may be readily extended into operative condition for use in the column.

To such ends this invention consists in a reinforcement for resisting the lateral stresses in columns, and having spaced, encircling reinforcement members and one or more spacing members directly secured thereto in such manner that the whole may be collapsed upon itself into compact form or extended into operative condition.

The invention further consists in the several novel features of construction and arrangement set forth in the following specification and particularly pointed out in the claims.

The invention is clearly illustrated in the drawing furnished herewith, in which—

Figure 1 is a side elevation of a reinforcement embodying the preferred form of the invention and showing the same in its extended or operative position, Fig. 2 is an end view thereof, Fig. 3 is a side elevation of the reinforcement shown in Fig. 1, but illustrating the same in its collapsed condition, Fig. 4 is an end view of the reinforcement in its collapsed condition and Fig. 5 is a fragmental side view of a spacing member showing a number of the encircling members in cross section and secured upon said spacing member.

Referring to the drawings, which show an embodiment of the preferred form of the invention, an encircling reinforcement element 10, will be seen, which element is adapted to act as a reinforcement for reinforced concrete columns and arranged to resist the lateral or transverse stresses that occur therein. Said encircling reinforcement element may be made in various forms, and as shown comprises a spiral band, the coils or turns of which may be spaced apart to suit the particular conditions in any given case. Said spiral band may be made of round rod or wire of proper diameter, but it is obvious that various other forms of strain resisting elements may be used. For maintaining the coils of said encircling reinforcement element in spaced relation to each other, spacing members 11, 11^a, are provided, which as shown may have seats 12, adapted to receive the coils of the encircling reinforcement element 10. It is preferred to secure said encircling members in the seats 12, and to accomplish this, overhanging portions are provided upon the spacing member, which as shown may comprise tongues 13, that may be clenched over the portions of the encircling members confined in the seats.

Many forms of spacing members are well known to those skilled in the art, and may be substituted for the one shown in the drawings without departing from the spirit of this invention.

It is preferred to employ two or more spacing members, two of which 11^a, are arranged diametrically opposite to each other as shown in Figs. 1 and 2, which spacing members act not only to space the several coils or turns of the encircling reinforcement elements, but to provide means whereby said encircling reinforcement may be moved into condensed condition. When the particular form of spacing member shown in the drawing is used, the tongues 13 may be clenched down upon the encircling members sufficiently to retain the same in their seats, but not firmly enough to prevent the several coils of the encircling reinforcements from turning in the seats. When more than two spacing members are used in the device, said extra spacing member or members should be loosely secured upon the encircling members so that they may be slid around upon the encircling members until brought adjacent to the stationary spacing members 11^a. When only two spacing members are used, it is evident that the reinforcement may be collapsed into condensed form by simply forcing the spacing members 11^a, in opposite directions as indicated by the arrows *a*, in Fig. 1, until the parts are brought into the collapsed condition seen in Fig. 3. In this condition the parts are brought into the compact form and the parts may be

easily handled and will occupy considerably less space than the parts would in their extended form. To bring said condensed reinforcement into operative position, the bars 11ª, are moved in opposite directions, as indicated by the arrows *b*, in Fig. 3, until the parts assume the original position shown in Fig. 1. When more than two spacing members are employed in the device, the other spacing members are first shifted around until they occupy the position shown in dotted lines in Fig. 2; that is to say, they are brought close to the stationary spacing members 11ª, so that the seats thereof will be in register with each other, whereby the seats will act as fulcrums or bearings, in which the several coils of the encircling element may turn. This form may then be condensed by simply shifting the groups of spacing members longitudinally in opposite directions as before, and the reinforcement may be extended into operative form by re-shifting the spacing members and subsequently moving the intermediate spacing members into such positions that all will be symmetrically disposed with respect to each other. After this has been done, the tongues of the spacing members may be clenched down if desired, to more rigidly fasten the encircling members to the spacing members.

The advantages of this device are readily apparent. The condensed structure can be handled easier, occupies less room in storage, and reduces the cost of transportation on account of the reduction of space occupied.

While I have shown and described the preferred form of the invention, it is to be understood that various modifications and arrangements of the several parts may be made without departing from the spirit of the invention, and I do not desire, therefore, to limit myself to the exact construction shown and described, except as may be necessitated by the state of the art.

I claim as new and desire to secure by Letters Patent:

1. A reinforcement for reinforced concrete columns, comprising an encircling reinforcement element having a plurality of spaced encircling members, and spacing bars for said encircling reinforcement element having notches in which the reinforcement members of the reinforcement element are rotatively secured and having overhanging portions for loosely holding said encircling members in the notches, whereby said spacing members may be shifted longitudinally of themselves to bring said encircling reinforcement into collapsed form.

2. A reinforcement for reinforced concrete columns, comprising an encircling reinforcement element having a plurality of encircling members, a pair of diametrically opposed spacing members having seats formed therein for receiving and spacing apart said encircling members and overhanging portions for loosely retaining said encircling members in their seats, said seats acting as bearings in which the encircling members may turn, whereby said spacing members may be shifted relative to each other to collapse the reinforcement into compact form.

3. A reinforcement for reinforced concrete columns, comprising a spiral reinforcement, a pair of diametrically opposed spacing members having seats formed therein at definite, fixed, points thereon for loosely receiving and spacing the several coils of the spiral reinforcement member, said spacing members being adapted to be shifted relative to each other to collapse the reinforcement into compact form.

4 A reinforcement for reinforced concrete columns, comprising a spiral reinforcement member formed of a round rod, a pair of diametrically opposed spacing members having notches formed therein for receiving and spacing apart the several coils of the spiral reinforcement member and overhanging tongues arranged to loosely secure said coils upon the spacing members, said spacing members being adapted to be shifted relative to each other to collapse the spiral reinforcement into compact form.

5. A concrete column reinforcement unit, comprising a spiral band and spacing bars for spacing the coils apart, the several coils of the band being rotatively secured in seats formed in said spacing bars, and being capable of movement into collapsed form while connected with the spacing members.

In witness whereof I have hereunto subscribed my name at Chicago, Cook county, Illinois, this 1st day of August 1910.

EDWARD McCLURE.

Witnesses:
FANNIE F. RICHARDS,
CHARLES O. SHERVEY.

W. H. BURK.

SPACING DEVICE FOR REINFORCING RODS IN CONCRETE STRUCTURES.

APPLICATION FILED JAN. 25, 1911

1,016,319.

Patented Feb. 6, 1912.

2 SHEETS—SHEET 1

Fig. 1.

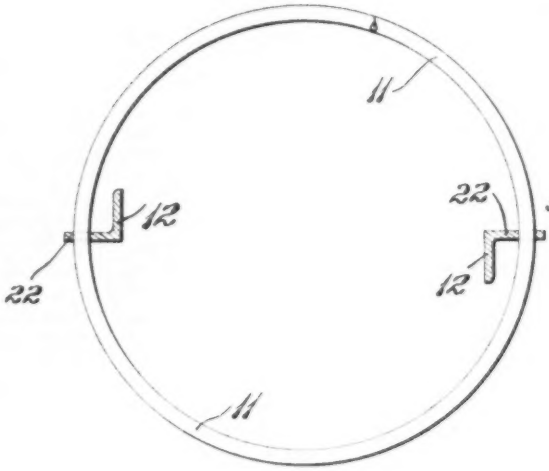


Fig. 3.

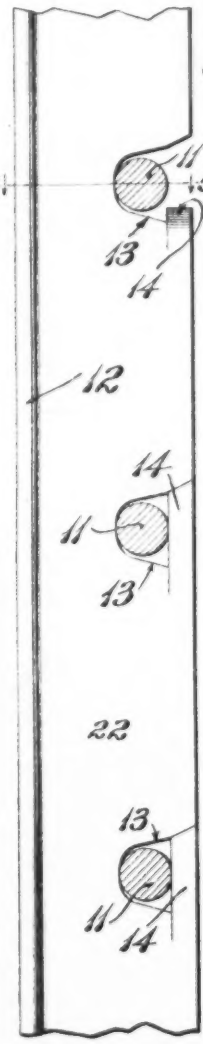


Fig. 4.

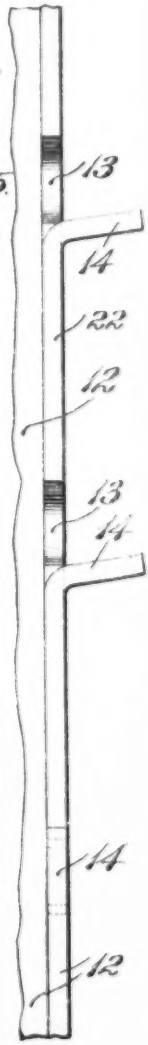
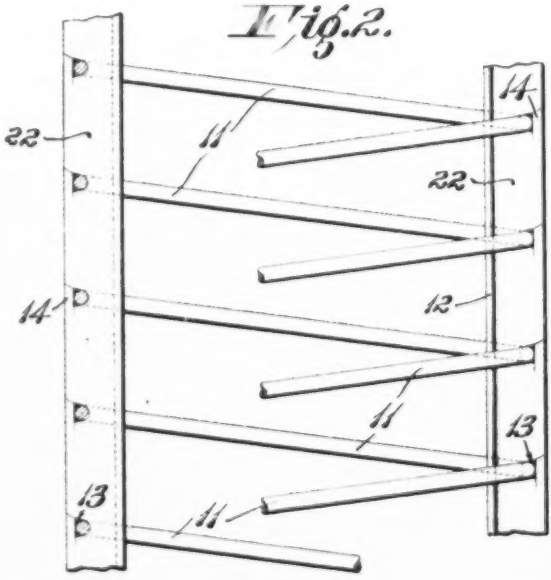


Fig. 2.

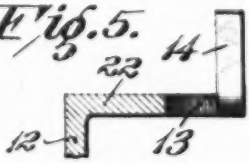


Witnesses:

Edgar F. Farrell

Alexander

Fig. 5.



Inventor:

William H. Burk,

By Cornet Cornet

attys.

297

W. H. BURK.

SPACING DEVICE FOR REINFORCING RODS IN CONCRETE STRUCTURES.

APPLICATION FILED JAN. 25, 1911.

1,016,319.

Patented Feb. 6, 1912.

2 SHEETS-SHEET 2.

Fig. 6.

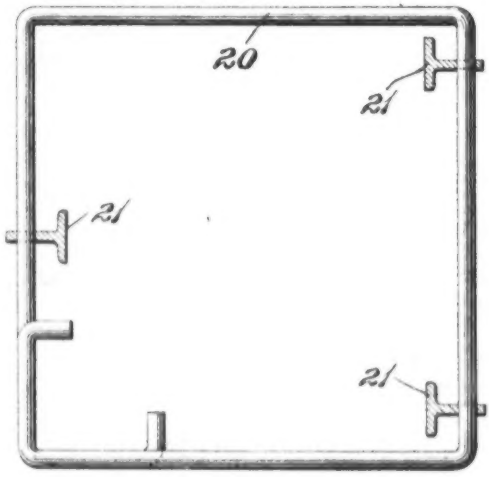
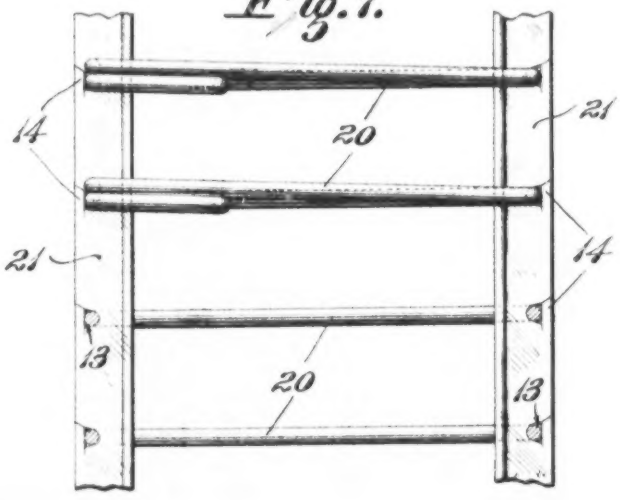


Fig. 7.



Witnesses:

Edgar T. Farmer.

A. W. Holcombe.

Inventor:

William H. Burk,

By Cornet Cary

attys

UNITED STATES PATENT OFFICE.

WILLIAM H. BURK, OF ST. LOUIS, MISSOURI, ASSIGNOR TO CORRUGATED BAR COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

SPACING DEVICE FOR REINFORCING-RODS IN CONCRETE STRUCTURES.

1,016,319. Specification of Letters Patent. Patented Feb. 6, 1912.

Application filed January 25, 1911. Serial No. 604,686.

To all whom it may concern:

Be it known that I, WILLIAM H. BURK, a citizen of the United States, and a resident of the city of St. Louis and State of Missouri, have invented a new and useful Improvement in Spacing Devices for Reinforcing-Rods in Concrete Structures, of which the following is a specification.

My invention relates particularly to improvements in reinforced concrete columns, pipes, tanks or cylinders, but is applicable to any structure in which spiral reinforcement or a plurality of spaced parallel reinforcing bars is used.

The object of my invention is to provide a simple and efficacious means for securing the metal reinforcement in spaced relationship in the forms or molds preparatory to filling in the concrete in the process of erecting reinforced concrete columns and like structures.

Another object is to provide a secure and rigid mechanical connection between reinforcing rods and a metal spacing device.

A further object of my invention is the production of a spacing device formed from rolled stock of usual shape, such as the ordinary sizes of structural steel and merchant iron, as such stock can be easily and cheaply secured, and I also desire to produce a device which is suitable for transportation without being boxed or crated, and which can be shipped in standard sizes and lengths and cut up at the place of use to suit the work in hand.

Two embodiments of my invention accomplishing these objects are shown in the drawings accompanying this application, in which like numerals are used to designate like parts throughout the several views, and in which—

Figure 1 is a horizontal section through my spacing device used with a spiral reinforcing bar; Fig. 2 is a partial view partly in section and partly in elevation of the same; Fig. 3 is a partial side view of my spacing device showing horizontal bars inserted therein in section; Fig. 4 is a partial side view of my spacing device looking at the edge of the notched flange; Fig. 5 is a section on the line 5—5 in Fig. 3; Fig. 6 is a horizontal section through another form of my spacing device used with looped reinforcing rods; and Fig. 7 is a view in side elevation of the same showing some of the loops in section.

In the form of my invention shown in Figs. 1 to 5, the spacing device comprises a commercial angle-bar 12 provided with notches 13 on the edge of one of the flanges 22 thereof, into which notches the coils 11 of spiral metal reinforce may be inserted to space the coils at the proper distances from each other. Two or more spacing devices may be used with each spiral reinforce, as may be found desirable, to properly space the coils and secure them rigidly in this spaced relationship. The reinforcing member thus made up is ready to be placed as a unit in the form, after which concrete may be placed about it to make up the column or other structure desired without liability of the reinforce being distorted or knocked out of place during the placing of the concrete.

Figs. 6 and 7 show a metal reinforcing unit for a square column or other structure, in which separate loops of metal 20 are held in spaced relationship by spacing devices 21 T-shaped in cross section. The object of using angle-bars, T's, or similar structural shapes is to give lateral stiffness to the spacing device that the assembled structures may not easily be distorted by the accidental bending of the spacing members. Such rolled commercial structural shapes are readily procured in the market and may be shipped uncrated without danger of being injured.

In order to form a secure connection between the spacing device and the metal reinforce with which it is used I have arranged adjacent the notches 13 prongs or tongues 14 which are stamped from the edge of the flange 22 and bent transversely to the flange in the operation of punching out the notches. These prongs 14 are bent nearly at right angles to the plane of the flange 22 and on the side thereof away from the other flange of the angle bar. After the loops 11 of the reinforce are inserted in the notches 13 these prongs 14 are easily bent back to close the open edge of the notch and secure the reinforce therein. This is done at the place of use either before or after the assembled reinforcing member is placed in the form. The spacing members are made up at the factory, away from the place of

use, in lengths convenient for shipment, tied in bundles, and shipped uncrated. At the place of use they can easily be cut to suitable lengths.

For convenience in shipping the spacing device shown in Figs. 1 to 5, made from angle bars, the prongs 14 are bent away from the other flange of the angle-bar, so that looking at the end of the angle-bar the shape thereof is substantially that of a Z-bar, as shown in Fig. 5. These bars are readily packed together with flanges and prongs arranged parallel to each other and thus packed may be tied together and shipped without danger of the prongs being bent through rough handling, as the prongs will not project from the bundle so as readily to catch on adjacent objects. This particular form of spacing device thus lends itself very readily to shipment uncrated without liability of damage to itself, or of inflicting any injury on those handling it.

While I have described specific forms of my spacing device, I do not wish to be limited thereto, but what I desire to secure and protect by Letters Patent is as follows:

1. A spacing device for structural members comprising a longitudinal metal strip having a part projecting from one edge thereof at an angle to the plane of the strip and notches in the other edge thereof, and prongs having a length greater than their width adjacent said notches and projecting from said strip in an opposite direction to the part projecting from the other edge of the strip, the lateral width of said prongs being not greater than the thickness of the part projecting from the opposite edge of the strip.

2. A spacing device for metal reinforce comprising an angle-bar having spaced notches along the edge of a flange and flexible prongs integral with the flange and adjacent the notches, said prongs projecting at an angle to the plane of said flange, and lying in a plane parallel to the other flange and on the side of the first named flange away from the other flange of the angle-bar, the length and lateral width of the prongs being not greater than the width and thickness respectively of the opposite flange, whereby substantially a Z-shape section is formed.

WILLIAM H. BURK.

Witnesses:
A. M. HOLCOMBE,
M. A. SHELTON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents Washington, D. C."

1992

360

A. BINDLEY & C. J. MOGAN.

COLLAPSIBLE SPIRAL REINFORCEMENT FOR CONCRETE COLUMNS.

APPLICATION FILED NOV. 14, 1912.

1,115,490.

Patented Nov. 3, 1914.

Fig. 1.

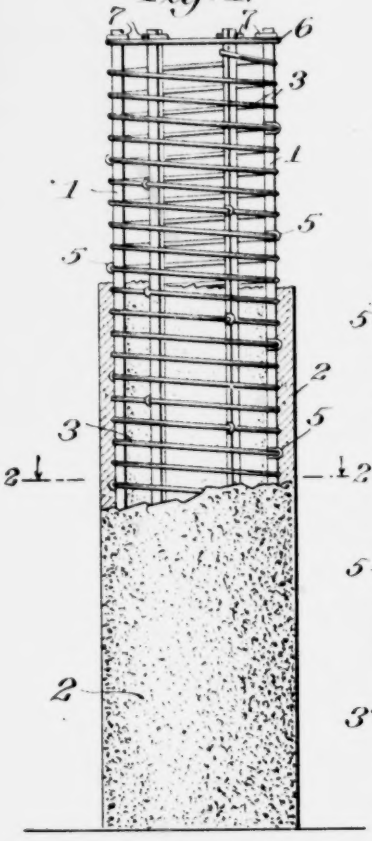


Fig. 3.

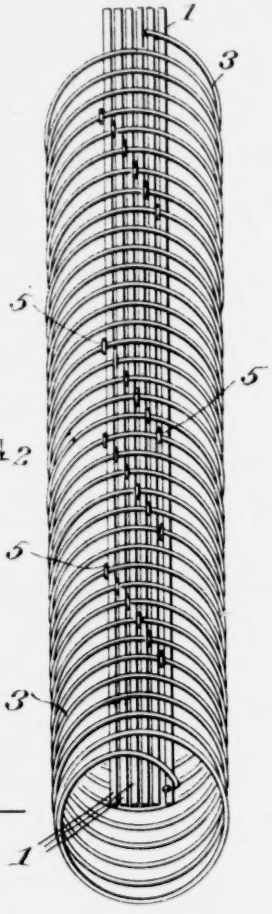


Fig. 4.

Fig. 5.

Fig. 2.

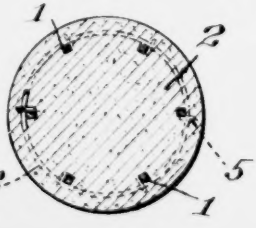


Fig. 6.

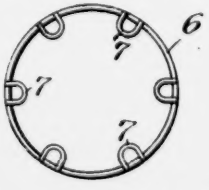
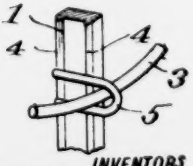


Fig. 7.



WITNESSES

Kathryn M. McMahon

Irene Lefhouse

INVENTORS

Albion Bindley

Christopher J. Mogan

BY

Townsend & Decker

ATTORNEYS

UNITED STATES PATENT OFFICE.

ALBION BINDLEY AND CHRISTOPHER J. MOGAN, OF CHARLEROI, PENNSYLVANIA, ASSIGNORS TO PITTSBURGH STEEL PRODUCTS COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

COLLAPSIBLE SPIRAL REINFORCEMENT FOR CONCRETE COLUMNS.

1,115,490. Specification of Letters Patent. Patented Nov. 3, 1914.

Application filed November 14, 1912. Serial No. 731,246.

To all whom it may concern:

Be it known that we, ALBION BINDLEY and CHRISTOPHER J. MOGAN, citizens of the United States, and residents of Charleroi, in the county of Washington and State of Pennsylvania, have invented certain new and useful Improvements in Collapsible Spiral Reinforcements for Concrete Columns, of which the following is a specification.

Our invention relates to a metallic reinforcement for concrete structures and particularly relates to such reinforcement for use in concrete columns.

The main object of the invention is to provide a construction which can be cheaply and simply built and which shall also be capable of being collapsed for convenience and cheapness of storage or transportation.

We are aware that it has heretofore been proposed to construct a reinforcement for concrete columns from a series of longitudinal or upright members and a surrounding or encircling member or members disposed and placed upon the upright members and tied or connected thereto, the encircling members being composed of separate, independent bands or the turns or elements of a continuous spiral. Various means have been employed for tying or connecting the encircling member to the upright or longitudinal members of the reinforcement and various constructions of longitudinal member have been employed to facilitate the connection and spacing of the encircling member. We are also aware that it has heretofore been proposed to secure the encircling member or spiral coil to the longitudinal members by notching the edges of the longitudinal members, seating the turns of the encircling member or members therein and closing over the free end of the metal at the notch to hold the encircling member therein in such manner that it will be free to turn. This method weakens the longitudinal members by punching the notches therein and also adds to the cost of construction by the added operation of forcing the free ends over the coils of the encircling member. We are also aware that it has been proposed to provide hooks projecting from the longitudinal members for securing the encircling members thereto but this also necessitates the added operation of turning over the ends of the hooks to secure the encircling member after being seated in the hooks.

The special object of this invention is to simplify the structure, cheapen its cost and particularly to avoid the cutting or slotting of the longitudinal or upright members as well as the added operation of turning or forcing over the ends of the notches or hooks in the manner heretofore proposed, while at the same time affording a proper spacing of the encircling member upon the upright or longitudinal members so as to permit it to turn at the point of connection to collapse the structure.

Heretofore when column reinforcements of this nature have been set up in extended position preparatory to being embedded in the concrete, they have been somewhat wabbly or shaky owing to the pivotal or swiveling connection between the parts.

It is also the object of this invention to avoid this objectionable feature providing means to make the collapsible structure rigid when set up in extended or operative position.

Our invention consists in the construction of metallic reinforcement for concrete columns hereafter more particularly described and then specified in the claims.

In the accompanying drawings, Figure 1 is a longitudinal section through a concrete column showing a metallic reinforcement therefor constructed in accordance with this invention, the upper portion of the column being broken away. Fig. 2 is a horizontal section on the line 2, 2 of Fig. 1. Fig. 3 is a front elevation of the metallic reinforcement in collapsed position, according to one method of collapsing the same. Fig. 4 is an edge view of the reinforcement when in the position shown in Fig. 3. Fig. 5 is a similar view showing another method of collapsing the structure. Fig. 6 is a plan view of the spacing ring detached from the structure. Fig. 7 is a perspective view of a portion of one of the upright or longitudinal members with a portion of the encircling member connected thereto in accordance with this invention.

1 indicates the upright or longitudinal members of the reinforcement. The number and size of these rods or bars will de-

pend upon the size of the column and the load to be carried, as well understood in the art, while 2 indicates the body of concrete in which the reinforcement is embedded.

3 indicates the encircling or surrounding member of the reinforcement comprising, by preference, a continuous rod or wire applied preferably around the outside of the longitudinal members 1 and maintained in spaced relation thereon by the means presently described. The longitudinal members may be round, square, flat or any other form in cross-section. Preferably they consist of rolled bars or rods rolled, by preference, with longitudinal ribs or ridges 4 at or near each edge thereof. (See Fig. 7.) These ribs or ridges may be formed in the rolling operation or they may be formed in any other desired or suitable manner. The ridges 4 form welding projections by which staples or eyes 5 are welded to the longitudinal members 1 and may be continuous or interrupted. The object of the ridges is to facilitate the welding of the staples or eyes 5 by means of the well known electric welding process and it will be understood that other forms of projections as well as other means for providing them might be employed to assist in readily welding the eyes to the members 1.

The members 5 for connecting the encircling member 3 to the uprights 1 are preferably U-shaped wire staples and they are welded to the ridges of the members 1 at the desired points throughout the length of the members so that they project laterally therefrom and form eyes through which the encircling member may be threaded. The welding of the staples or eyes to the members 1 is effected in any proper electric welding machine as will be readily understood by those skilled in the art and in the form shown the staples are secured at four separated points of weld, thus making a very strong joint. The eyes 5 of each member 1 may be spaced apart as desired, there may be one provided on each member for each coil or turn of the encircling member or adjacent upright members may take successive or alternate coils of the encircling member. The preparation of the upright members 1 at the desired points for the electric welding thereto of the eyes 5 in the proper spaced relation may be of any desired kind, as understood in the art, and it will therefore be understood that it would be within our invention to electrically weld the eyes 5 upon the members 1 in proper spaced relation by any expedient or by any desired welding means or operation. Preferably after the welding operation the coils or turns of the encircling member 3 are threaded through the eyes 5 so they become connected to the members 1. The connection between the coils 3 and the eyes 5 is such that the members 1 are free to be slid around the coil toward each other as shown in Fig. 3 and so that the coils are free to swivel or rotate in the eyes to collapse the column as shown in Fig. 4. To collapse the reinforcement, all of the members may be slid into sidewise proximity at one side of the coil as shown in Figs. 3 and 4 or some of them may be moved to one side and some to the side diametrically opposite as shown in Fig. 5 and as will be readily understood in the art.

The eyes 5 are preferably formed of pieces of round wire bent into U shape, but it will be understood that the invention is not limited to this specific form of eye member.

When the reinforcement is expanded into the position for embedding in the concrete, a spacing member 6 is preferably provided at each end of the structure to properly space the longitudinal members 1 from each other and to hold the structure rigid. The spacing member consists of a continuous band preferably of the same conformation as the coils of the reinforcement, the case illustrated being a ring, and is provided in the proper spaced relation with a plurality of clips forming eyes 7 welded to the ring 6. The eyes 7 slip over the ends of the longitudinal members 1 and hold them rigidly in position.

While the invention is particularly useful for reinforcement for concrete columns, pillars, posts or other upright structures, composed of concrete and having the reinforcement embedded therein, we do not limit ourselves to this particular general form of reinforcement, the invention being applicable to other forms comprising essentially a series of longitudinal members and an encircling or surrounding member or members maintained in spaced relation thereon and rotatably mounted in the eyes of one or more of the upright members. It will also be understood that the invention is not limited to locating the encircling member 3 on the outside of the longitudinal members as the same might, if desired, be disposed on the inside of these members in which case the eyes 5 would project laterally toward the center of the structure.

By this invention the necessity of weakening the upright members or causing waste of material by punching out notches to provide seats for the encircling member as well as the necessity of forcing over the ends of hooks or other fasteners to hold the encircling member to the uprights is avoided.

What we claim as our invention is:—

1. In a metallic reinforcement for concrete, a series of longitudinal members provided with welding projections, individual and independent eye members welded at one end to said longitudinal members by said projections and an encircling member hav-

ing its turns threaded through said eyes whereby the turns are adapted to rotate therein to collapse the structure.

2. A reinforcement for concrete columns, comprising a plurality of longitudinal bars, U-shaped members having their ends welded at four points to said bars on the same side thereof and forming eyes at one side of said bars and a spiral coil, the turns of which are located in said eyes and free to rotate therein to collapse the structure.

3. In a collapsible reinforcement for concrete columns, a plurality of longitudinal bars, an encircling spiral rotatively connected to said bars to permit the structure to be collapsed and a spacing ring having clips welded thereto, said clips engaging the longitudinal bars when the structure is in extended position to rigidly couple the members together.

Signed at Monessen in the county of Westmoreland and State of Pennsylvania this 4th day of November A. D. 1212.

ALBION BINDLEY.
CHRISTOPHER J. MOGAN.

Witnesses:
EDWARD H. BINDLEY.
W. W. MCNEILL.

C. A. P. TURNER.

COLUMN REINFORCEMENT AND METHOD OF MAKING THE SAME.

APPLICATION FILED JULY 18, 1911.

1,159,297. Patented Nov. 2, 1915.

Fig. 1.

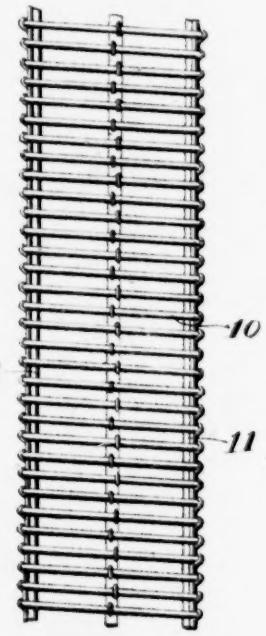


Fig. 2.

Fig. 3.

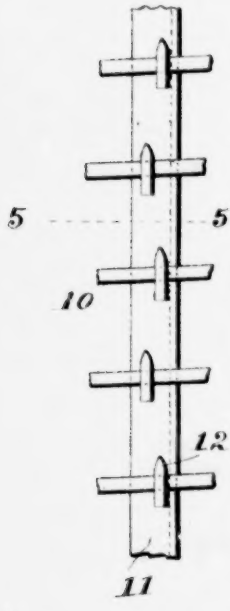


Fig. 4.

Fig. 5.

Witnesses
George L. Barnes
A. F. Haigel

Inventor
Claude A. P. Turner
By Chas. J. Williamson
Attorney

UNITED STATES PATENT OFFICE.

CLAUDE A. P. TURNER, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO C. A. P. TURNER COMPANY, OF MINNEAPOLIS, MINNESOTA.

COLUMN REINFORCEMENT AND METHOD OF MAKING THE SAME.

1,159,297. Specification of Letters Patent. Patented Nov. 2, 1915.

Application filed July 18, 1911. Serial No. 639,178.

To all whom it may concern:

Be it known that I, CLAUDE A. P. TURNER, of Minneapolis, in the county of Hennepin, and in the State of Minnesota, have invented a certain new and useful Improvement in Column Reinforcements and Methods of Making the Same, and do hereby declare that the following is a full, clear, and exact description thereof.

The object of my invention is to provide a construction of reinforcement for columns, and the like of concrete, which will be economical to make, light in weight to save freight, and capable of being collapsed or folded down for shipment, to save room and to avoid damage in shipment.

In the accompanying drawings—Figure 1 is a side elevation of a section of column reinforcement embodying my invention; Fig. 2 is an end view thereof; Figs. 3 and 4 are detail enlarged views in side elevation of a portion of one of the spacing bars; and Fig. 5 is a horizontal section on the line 5—5 of Fig. 3.

My invention relates more particularly to the type of column reinforcement in which heavy wire is wound into a spiral, or helical form, and the coils thereof are spaced or held separated suitable distances apart by parallel bars that engage the coils at the desired distances apart. Such a helical form of reinforcement 10 is shown in the drawings, and the coils thereof are engaged and held spaced apart by several, preferably, two light bars 11, the coils being caught by offset curved fingers or hooks 12 integral with the bar, which are formed therefrom by shearing, and offsetting the bar at the desired points, the shear being of such shape that the offset is produced before the complete severance at one end to form the hook, is effected. This procedure in the formation of the hooks saves the offsetting as a separate operation. The bars 11 are light, and preferably they are of angle iron. When the pitch of the coil is slight so that adjacent coils are close together, the engaging tongues or hooks are situated in a staggered, or alternating arrangement as shown in Fig. 3. It will be noted that the fingers, or hooks 12 by reason of their form, or configuration provide a hinge-form connection with the coils of the helix that enables the collapsing and opening out of the structure. This form or configuration of the hooks is that of a reversed curve, that is to say from the point of connection of the hook with the bar, from which it is formed, it curves upward and outward and then around the adjacent coil of the helical reinforcement, which being round in cross section where the hook curves around it provides a snug, or close engagement with the hook that makes a real pivotal connection between the helix and the bar that maintains the proper spacing between the helix coils.

I use but two spacing bars 11 and place them at diametrically opposite points, for thus the coil can be flattened or collapsed, as there can be a turning movement of the individual turns relative to the bars, due to the pivotal connection afforded by the tongues or hooks, and thus the bulk of the reinforcement can be reduced, for, and danger of damage in shipment diminished. Yet, it can easily be restored to its circular or cylindrical form.

Having thus described my invention what I claim is—

A reinforcement for concrete columns, comprising a spiral forming a plurality of spaced circular encircling members round in cross section and spacing bars having integral clips struck out wholly from within the strip body and attached thereto at one extremity and overlying portions of said encircling members and bent thereover in a reverse curve and confining the same against the side of the bars, a pivotal connection being thereby formed between the encircling members and the bars, said bars being two in number and situated diametrically opposite each other.

In testimony that I claim the foregoing I have hereunto set my hand.

CLAUDE A. P. TURNER.

Witnesses:
CHAS. J. WILLIAMSON,
A. T. HAYES.

W. B. HOUGH.

REINFORCEMENT FOR CONCRETE CONSTRUCTION.

APPLICATION FILED MAR. 29, 1912.

1,172,026.

Patented Feb. 15, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

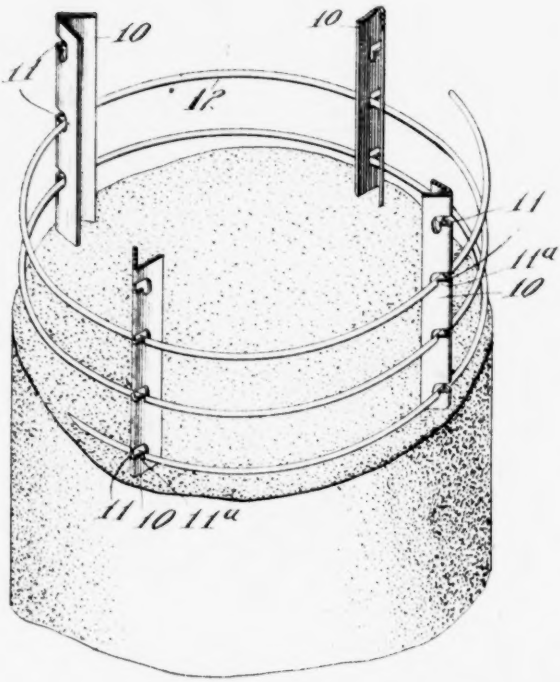


Fig. 3.

Fig. 2.

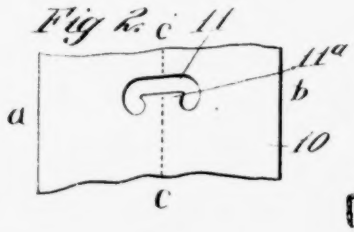


Fig. 6.

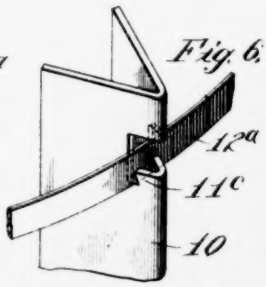


Fig. 4.

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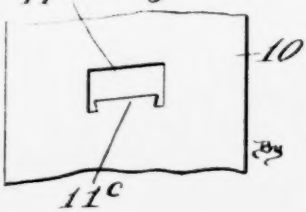
Fig. 5.



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W. B. HOUGH.

REINFORCEMENT FOR CONCRETE CONSTRUCTION.

APPLICATION FILED MAR. 29, 1912.

1,172,026.

Patented Feb. 15, 1916.

2 SHEETS—SHEET 2.

Fig. 8.

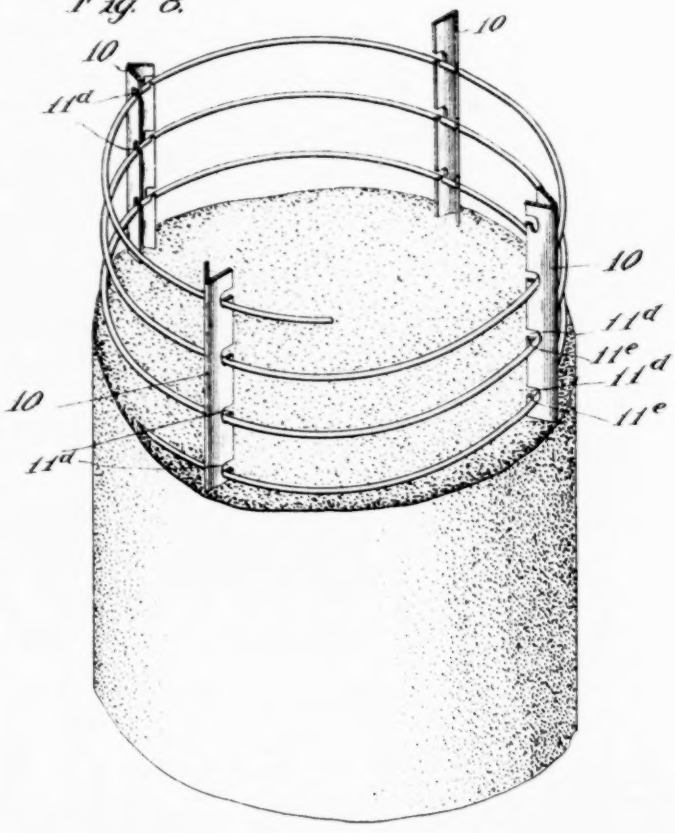
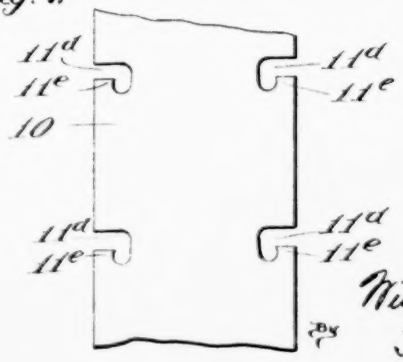


Fig. 7.



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UNITED STATES PATENT OFFICE.

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REINFORCEMENT FOR CONCRETE CONSTRUCTION.

1,172,026. Specification of Letters Patent. Patented Feb. 15, 1916.

Application filed March 29, 1912. Serial No. 687,175.

To all whom it may concern:

Be it known that I, WILLIAM B. HOUGH, a citizen of the United States, and resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Reinforcements for Concrete Construction, of which the following is a description, reference being had to the accompanying drawings, which form a part of my specification.

My invention relates more especially to metal reinforcements for concrete construction, such as columns, piles, and the like, whereby an efficient and at the same time inexpensive binder or device is produced which will greatly increase the strength of a column or upright, as will be readily understood from the description herein.

The object of the invention is to produce a reinforcement or device composed of as few parts as would be consistent with practical construction capable of being readily assembled, and which will permit of being folded or put into a collapsed condition for the purpose of shipment or storage, while at the same time permitting it to be quickly extended or set up in proper position without the necessity of special fitting.

The invention is more especially intended for use in connection with the usual forms employed to receive or incase the cement or concrete in which the reinforcement is to be embedded as will be thoroughly understood from the following detailed description of the drawings, wherein:—

Figure 1 is a perspective view of my improved reinforcement shown in its assembled and "set up" condition, being partially embedded in concrete formed in the nature of an upright or column. Fig. 2 is a detail view of a portion of the spacer-blank or vertical member, showing the manner of forming the retaining sockets or openings before the blank has been bent into the desired shape. Fig. 3 is a cross sectional view taken on the line *a*—*b* of Fig. 2, with the spacer-blank bent at its longitudinal center line so as to bring the socket or opening at an outer edge where it is to receive the round or coil of the encircling member of the reinforcement. Fig. 4 is a similar view, illustrating the spacer or vertical member in a slightly expanded condition after the rounds or coils of the encircling element or means have all been inserted in place. Fig. 5 is a detail view of a portion of a spacer-blank shown in elevation, illustrating a modified form of my invention. Fig. 6 is a perspective view of the modified form, showing the spacer-blank or upright bent into proper shape, with a portion of a round or coil of the encircling member or means, also of modified form, shown seated in place. Fig. 7 is a detail view of a portion of a spacer-blank showing another modified form of my invention. Fig. 8 is a perspective view of the assembled reinforcement employing the modified form of spacer-blank or upright shown in Fig. 7; the reinforcement being shown embedded in a concrete column or upright.

For the purpose of illustrating my invention when in its assembled or "set up" condition and the manner of its application, I show the same, in Fig. 1, partially embedded in concrete.

The invention consists of a suitable number of spacing members or elements 10, circumferentially arranged in a vertical position as clearly shown in Fig. 1. The spacing members 10 are preferably formed of strips of flat sheet metal, as illustrated in Fig. 2, provided with suitably spaced cut-out portions 11, arranged preferably at the longitudinal center line of the spacing members. As the spacing members, in the preferred form of my invention, are intended to receive the successive turns or coils of a continuous encircling member, I prefer to arrange the slots 11 at a slight incline, as shown in Fig. 2, so that the slots may coincide with the slight incline of the respective turns or coils of the encircling member; the slots 11, of course, corresponding in number with the number of turns or coils in the encircling element.

The cut-out portions or slots 11 are intended to form pockets or sockets for the turns or coils of the continuous encircling spiral member 12, or for encircling means, when the members 10 have been bent into proper form, which is accomplished by preferably bending the same substantially at the longitudinal center line thereof, as indicated by the dotted line *c* in Fig. 2, or along a line that extends through the longitudinally arranged series of openings, thus providing two portions or legs *a*—*b* arranged perpendicular or at an angle to the encircling means or member 12, as clearly shown in Figs. 1 and 3.

It will be seen that the bending of the spacing means or members in the manner described will bring the cut-out portions or openings at the vertex or bent edge of the spacing means, and provide suitable sockets for the reception of the respective turns or coils of the encircling element 12 or portions of the encircling means.

The slot or opening 11, in the construction illustrated in Figs. 1 to 4, has its ends depended downwardly and slightly presented toward each other, as more clearly shown in Fig. 2, thus providing an intermediate projecting portion 11^a the opposite upper edges whereof slightly extend into the slot, as clearly shown in Fig. 2. The ends of the slot or opening which extend slightly beneath the upper edges of the intermediate portion or tongue 11^a form the sockets or "seats" for the coils or turns of the encircling means or member 12 when the upright or spacing members have been bent into proper form, as shown in Fig. 3.

The intermediate portions 11^a of the respective slots, it will be seen, will prevent the accidental removal of the coils of the encircling means or member. After all of the coils or turns of the encircling member have been properly placed in their respective slots, the vertical or spacing members 10 are preferably slightly expanded as shown in Fig. 4. By thus expanding the members, the coils or turns of the encircling member will be forced into the ends of the opening so as to come slightly beneath the extended corners of the intermediate or lip portion 11^a and be firmly held in place. The vertical or spacing members 10 will properly maintain the different coils or turns of the encircling means in the proper separated or spaced relation to each other.

The encircling means 12 in Figs. 1 to 4, is shown in the nature of a continuous or spiral wire, which is adapted to resist the lateral or transverse stresses that occur in the columns or upright members of the concrete construction. The encircling means may, however, be made in various forms and of any desired length; for example, in Fig. 6, the encircling means is shown in the nature of a flat member or band 12^a, rectangular in cross section. When this form of encircling member is employed, the spacing members 10 are provided with the substantially rectangular cut-out portions or slots 11^b, see Fig. 5, the lower corners whereof are extended downwardly so as to provide the intermediate portion or tongue 11^c. The upper corners of the intermediate portion 11^c preferably extend slightly into the cut-out portion as clearly shown in Fig. 5.

When the coils or turns of the encircling member 12 have been inserted in their respective slots in vertical member or spacer 10, the coils or turns will be seated in the extended lower portions of the slot, as clearly shown in Fig. 6. The spacing member 10 may then be slightly expanded, as shown in Fig. 4, which will bring the extended upper corners of intermediate portion 11^c into frictional engagement with the encircling means, thereby causing the coils or turns of the encircling element 12^a to be firmly gripped or clamped against accidental removal.

Where the encircling member is of considerable diameter, I prefer to employ a number of spacing members so as to properly maintain the coils or turns in the desired spaced relation throughout their length.

The spacing members 10 not only act as spacers for the different coils or turns of the encircling element 12, when the reinforcement is in "set up" position, but the spacers also provide means whereby the encircling element may be readily put into a condensed or collapsed condition. It is evident from the construction shown and described, that the spacing members may be readily slid along the coils or turns of the encircling member, especially when the legs or sides of the spacers are slightly contracted, so that the spacing members, where more than two are employed, may be assembled or brought together at two points diametrically opposite each other. This will permit the assembled spacing members on opposite sides of the encircling element to be moved or forced in opposite directions, thereby bringing the parts of the reinforcement into a collapsed condition with the coils or turns of the encircling element extending almost parallel with the spacers. By putting the reinforcement into the compact form just described, it may be easily handled and at the same time occupy considerably less space than would be the case if it were necessary to maintain the reinforcement in its extended or "set up" condition. To place the reinforcement into its extended or "set up" condition, it is merely necessary to move the oppositely disposed spacing members in a direction opposite to that when collapsing the reinforcement, which will bring the parts into proper position, as shown in Fig. 1.

In Figs. 7 and 8, I show still another modified form of my invention, wherein the upright or spacing members are provided with slots in their outer longitudinal edges instead of in the bent edge or vertex thereof. The slots shown in Figs. 7 and 8 are substantially similar to those shown in Fig. 1.

The slots 11^d extend into the blank from the opposite longitudinal edges, with the respective slots at the opposite sides of the blank arranged substantially in the same plane with each other, and have their inner ends curved downwardly similar to the man-

ner shown in Fig. 2; the inner ends of the slots curve slightly toward the outer edge of the blank, so as to provide the portion or tongue 11^c, beneath which the rounds or coils of the encircling means will be seated.

After all the coils or turns of the encircling means have been placed in their respective slots, the spacers 10, shown in Figs. 7 and 8, are expanded. This will maintain the coils or turns of the encircling means within the slots at a point beneath the tongues 11^c, where they will be firmly gripped.

In Fig. 8, I illustrate another method of assembling the various elements of my improved reinforcement, whereby the spacers are arranged outside of the encircling means, so that the bent or nose portion of the spacers will act as a spacing means or gage to maintain the proper relative position of the encircling means to the outside casing or form.

In practice, the concrete surrounds the different members or elements of the reinforcement on all sides and fills in between the coils or turns of the encircling means and also fills in the openings or slots adjacent the rounds or coils as shown in Fig. 1, so that the reinforcing device and the concrete will be firmly united.

The different members of the reinforcement may be of any desired length and the encircling means may be of any desired size or width.

I have shown and described various forms of my invention as well as different methods of employing the same, but it is apparent that other alterations and modifications may be made without, however, departing from the spirit of my invention. I do not wish, therefore, to limit myself to the specific forms shown and described, but

What I claim as my invention, and wish to secure by Letters Patent, is:—

1. A reinforcement for concrete construction, comprising encircling means, and a plurality of spacers arranged lengthwise of the encircling means, the spacers consisting of sheet metal blanks bent longitudinally so as to provide angularly expansible members, with the portion of said members adapted to contact with the encircling means being provided with transversely extending slots arranged in longitudinal series and of width adapted to permit insertion of the encircling means laterally, the ends of the slots arranged to receive the encircling means being extended downwardly and slightly rearwardly so as to provide an intermediate portion having upwardly presented lips extending into said slots so as to provide restrictions at points where the slots are disposed downwardly, said lips being adapted to grip said encircling means and prevent lateral displacement thereof when said members are expanded.

2. In a reinforcement for concrete construction provided with an encircling element, spacing means comprising blanks of sheet metal bent longitudinally so as to provide angularly expansible members, said members being provided with transversely disposed slots of width adapted to permit lateral insertion of an encircling element, said slots being arranged in longitudinal series with the ends of the slots being extended downwardly and slightly under the main portion of the slots so as to provide upwardly presented portions having corners or lips adapted to form restrictions at points where the slots extend downwardly and thereby provide gripping portions, whereby an element inserted in said slots will be held against lateral displacement when said members have been expanded.

WILLIAM B. HOUGH.

Witnesses:
GEORGE HEIDMAN,
R. E. WIGHTON.

DEFENDANT'S EXHIBIT AA-1.
British Patent.

A. D. 1874, 14*th May*. No. 1715.

CONSTRUCTING BUILDINGS, ETC.,

LETTERS PATENT to Thaddeus Hyatt, of Gloucester Gardens, Hyde Park, in the County of Middlesex, Manufacturer of Patent Lights, for the Invention of "Improvements in constructing, lighting, ventilating and fireproofing buildings, partly applicable to building materials and appliances, and to ships."

Sealed the 24th July, 1874, and dated the 14th May, 1874.

PROVISIONAL SPECIFICATION left by the said Thaddeus Hyatt at the Office of the Commissioners of Patents, with his Petition, on the 14th May, 1874.

I, THADDEUS HYATT, of Gloucester Gardens, Hyde Park, in the County of Middlesex, Manufacturer of Patent Lights, do hereby declare the nature of the said Invention for "Improvements in constructing, lighting, ventilating and fireproofing buildings, partly applicable to building materials and appliances, and to ships," to be as follows:—

The erection of combustible buildings being partly if not mainly, attributable to the ease and cheapness of obtaining materials for such constructions and the difficulty of obtaining cheap and reliable fireproof appliances and materials to make buildings safe, that Invention is most deserving which deals

practically with the subject, by putting upon the market the means for making the construction required.

My improvements have reference therefore to the requirements of trade, for whenever it becomes as profitable to sell fireproof and fire-proofing building appliances and materials as to deal in the other sort, then the community will get the benefit and security of fire-proof houses.

According to another part of my Invention connected with the foregoing, I make openwork corrugated sheet metal by cross corrugating the metal, and cutting the flat portions included within the corrugations so as to form tongues, which tongues are bent outwards, thereby presenting a good holding surface on both sides of the sheet for holding any plastic fire-proofing material with which it may be overlaid. These sheets of metal are light, cheap, and easily applied as fireproof seating to all parts of buildings. When bent in U form and filled with Portland cement, concrete or "beton coignet," these cross corrugated sheets make excellent floor beams for short spans, and if applied side by side on the "all-beam principal," fireproof floors of considerable span may be safely made of them.

According to another method of making fire-proofing sheathing plates of cross corrugated metal, I stamp or press the metal up so that the portions included within the corrugations obtain a considerable elevation, I then perforate the sides of these elevated parts without destroying their shape or strength, so as to admit the plastic filling to pass

through the openings and to thus key itself to both sides of the sheet.

According to another part of my Invention I make beams of interlaced strips of metal or of woven wire shaped and conditioned not only to firmly hold the cement or concrete which fills its interstices, as a part of the body for its protection against fire, but also for its value in resisting compressive strains. These lattice beams may be of various from, box, tubular, H and T shaped, in section.

By one method I braid the metal ribbons or strips into hollow tubes after the manner of braiding whip stocks. These tubes I then use in the shape thus made with the addition of a cement or concrete covering and lining and a special tie rod fastened along its middle bottom line inside the tube, or I place the tube as made in suitably shaped dies, and by mechanical appliances I bring it into some other shape, such as a hollow web and flange or otherwise, and then overlay and prepare it as described.

According to another plan I wind the metal strip or strips around a mandril, and make thus a long spiral closely or loosely coiled and of the length desired. To this coil I attach a tie properly fastened, I then fill and overlay it with cement, concrete or their equivalents. This beam I further perfect in some cases by a metal tie at the top to give it metallic strength, both at the top and bottom.

By another method of operating I make an openwork skeleton beam, or several of them, on a sheet of metal by slitting the sheet, and drawing the metal

ribbons or strips thus made outwards in opposite directions so as to form a hollow openwork tube which may be variously shaped, I then place and fasten a tie in the manner already described, and protect and strengthen the construction by means of cement or concrete as already described.

According to another part of my Invention I combine web and flange beams in a floor construction, upon a system which practically converts each pair of beams into a hollow tube, with reference to the holding and binding power of the top flanges upon the concrete filling underneath them, between the webs of the beams. In this system the beams are placed near enough together to practically form hollow tubes, and of consequence are made as much lighter as there are more of them; the system being the use of a large number of thin light beams set near together in opposition to a few heavy ones set wider apart. These thin light beams I prefer to make with flanges very much wider than are commonly made on such beams, and I prefer to bind a number of them together by cross tie rods passing through openings at the centre of the web of the beams.

According to another part of my Invention I make hollow beams of thin metal of any suitable or known form, and prevent the collapsing of these hollow beams by means of a filling or lining of cement within them.

In the Specification of my Patent, No. 3124, A. D. 1871, I have described tubular beams for an "all-

beam floor," which are cylindrical in shape and in some cases filled solid with fireproofing materials.

By my present improvement when I make a beam in the form of a hollow cylinder, I strengthen it from its interior not by loading it with a complete solid interior filling, but by a lining which may be earthen tubes cemented together within it or a cement or concrete tube formed within it over a core which is afterwards withdrawn. By one plan of construction I make these hollow beams double, that is to say, of two metal tubes one within the other, the interior one by preference being set eccentrically to the outer one, and made fast to it along the middle bottom line of the tubes, the space between them will then be crescent shaped and the concrete filling therein be thickest at the top in the plane of the compressive strain. Tie rods may be added for additional strength, and when so added I use them in the form of a flat bar which I place inside the tubes and there rivet and protect by plaster of Paris or other fire-resisting material. These hollow thin metal beams I also make in all the forms in which solid cast and wrought iron beams are usually fashioned, and I fill the interior space with cement or concrete which preserves it from collapsing. These beams require additional metal for tie rods which I add in the form of flat bars rivetted to the bottom of the beam, as already described.

According to one method I make these beams of perforated sheets of metal, by means of which the exterior coating of cement becomes keyed or interlocked with the interior filling.

According to another part of my Invention I make rolled or cast solid beams with openwork webs for facilitating the incorporating and holding of cement, concrete, or other filling between the beams, and also for holding any fire-proofing material below the beams to protect the bottom flanges from fire.

According to one method the web of the beam is made with a range of openings of considerable size along the middle from one end to the other to admit the interlocking of the concrete from one side to the other of the beam, or to admit the passage of cross bars, beams, tubes, or cylinders, in order to laterally connect, stiffen, and bind any number of beams together in a floor so as to distribute the weight that may come upon it. By a variation of the mode of thus laterally connecting the beams I make beams with countersinks upon their webs, in place of holes, of such a nature as to be capable of holding the ends of hollow tubes placed crosswise between the beams, cross tie rods being used to tighten the construction after the cross tubes are in position.

By another modification, where these large cross tubes are not employed, I form the beam with a range of holes or countersinks near the top flange, or, where no top flange is near the top of the web, for the purpose of holding small cross tubes or cross bars as binders to keep the concrete beneath them from breaking up under strain. But for the purpose of protecting the lower flange of beams against the destructive action of flame I form the beam with a light false flange and web, or with a web only.

This web is made with either a range of holes or a range of countersinks, like those already described for holding cross bars or tubes, and for holding any plastic or other fire-proofing material, the cross bars or tubes when employed also serving as a floor to hold in part the concrete above it between the beams, and as a ceiling to the room below.

In order to protect the lower flange of beams not made with false webs I have devised an appliance to serve the same purpose, which I term a "beam rider." This rider I make in several ways. According to one method, and which I think the best, it is made to be held in place by the weight and pressure of the concrete or other filling between the beams. For this purpose it is so shaped as to not only rest upon the flange, but also to run up behind the filling against the web of the beam, and where formed to overlap the flange at both sides thereof without covering the under face of the flange it runs up and over the top of the beam, resting upon it, and fitting is as a saddle does a horse. Made in this way and in sections they are easily applied when the beam is in position, but if made to be held by and to the lower flange only they would require to be either made in interlocking halves, or be slid upon the beam before it was put in place upon the walls, or be riveted or screwed to the flange. But my object is to avoid labor in attaching as well as needless expense in constructing these riders. The simplest plan therefore is the one to which I give the preference, and which consists merely of a strip of iron bent or made with two angles opposed to each other, the

strip having a horizontal face or seat to take upon the upper face of the flange on one side of the web of the beam, its upper portion from thence running vertically upward against the web of the beam some 3 or 4 inches, and its lower portion from its point of rest upon the flange of the beam running from thence perpendicularly downwards sufficiently far to furnish the required range of holes or countersinks to receive the cross bars or tubes for holding the fire-proofing material underneath the beams, and partially supporting as a flooring the concrete above it between the beams.

When required merely to protect the flange of a beam against fire and to carry no weight, I make them of wire or of perforated metal, or light cast iron, which may be coated with the fire-proofing material before being applied or after being placed upon the beam.

According to another part of this part of my Invention I make a light partition or sheathing material, applicable also as a roof in light constructions, and which for illuminating purposes may be set with glass, as follows:—I take strips or blades of thin metal, which I stamp with countersinks, as already described, and I connect any number of these strips together by means of tubes which fit between them into the countersinks, cross tie rods of wire being employed to tighten and bind the whole together into a sort of grating. This construction I then fill and overlay with any suitable plastic fireproof material to the depth required.

According to another part of my invention I make

a fire-proof beam, and by forming several of them together on the "all beam" principle of construction, I make floors and roofs of the same as follows, viz.:—I use a top and bottom rail of iron, the bottom containing the proper quantity of metal for the tie, and the top containing no more than sufficient for a firm construction, and I connect these rails together by vertical tie rods, which for convenience are made flat and provide at the top with a hole so as to be slid upon the upper rail, and at the bottom with another hole to be slid upon the bottom rail. For double or treble beams these vertical ties are in the form of sheets or plates, with as many holes at the top and correspondingly at the bottom as there are rails or rods to go through them. These vertical ties are placed at suitable distances apart upon the rails, and the intermediate spaces are filled in with cement, concrete, baked brick, or other suitable bracing material, so as to withstand compressive strains and act as a strut to the ties of the beam. I also introduce into these beams and floors under some circumstances as many additional or intermediate rails or rods between the upper and lower ones as may for the special purpose be required, all the rods or rails terminating at either end in a heel block or skew back, to which they are attached, and against which they are screwed up to tighten the mass. The vertical sheet metal ties I prefer to make with sharp and deep horizontal corrugations to take a good hold upon the cement. The bricks may be flat, as ordinary brick are made, but are preferably made to conform to the corrugated sheet ties. The

bricks which I employ for this construction may be solid or shaped to produce when put together tubular or other openings in the interior of the floors they form. I make them however of such form as to admit of their being as readily mortared and masoned together as in the laying of ordinary bricks, wherefore I form half-holes or notches in them at those points where they pass or overlap and lock upon the rails.

A feature of this construction, which is peculiar and constitutes a part of the Invention, is a wedge-shape or form which I give to the bricks, and the method I adopt for combining them together. In making a floor, roof, or walking surface of these wedge-shaped bricks I lay them in two courses, one vertical, the other horizontal. The vertical course break joint with themselves, and the horizontal courses break joint with themselves, and at the same time the vertical and horizontal courses break joint with each other. The vertical courses have their thick ends looking downwards, but the horizontal courses have their facing upwards. By this means the vertical courses, where they have a hold upon te rails, sustain the horizontals, and the horizontals, wheer they obtain a hold upon the rails, support the verticals, the entire series of bricks thus interlocking one another throughout the construction, which gives unity, mutual dependence, and strength to the whole.

According to another part of my Invention I make tubular bricks in the nature of short pipes, so short as to bear the term of collars. These collars or rings

are circular in the interior and square or flat-sided externally, but may vary as to this, it being immaterial whether the internal opening be circular, elliptical, or otherwise, except that I prefer the circular shape for strength. The bricks in this construction are made with shoulders to enter one another when put together end to end, so as to make a perfect tube or tubular beam of the four sides of the bricks; two, the upper and the lower, form respectively floor and ceiling, while the other two clasp metal rails or ties on the right and left, each brick upon these sides being formed with ledges to overlap, underlap, and thus enclose the metal.

A feature in this construction, and which also forms a part of the Invention, consists in the formation of the sides of the bricks, so that while they break joint with each other each range of bricks also interlocks one with the other, thus preventing any single brick from dropping out of its place in the series, should its hold upon the metal become broken.

Another feature of this construction consists in the employment of cross tie rods for binding the parts or ranges of bricks together laterally as above described. The rails or ties mentioned are in the nature of flat bars on edge or I rails or angle iron; one bar only upon each side of any single brick, and between ever two adjoining ones. But I contemplate making these bricks to be used with an upper and lower rail or rod on each side, as herein-before described in connection with the wedge-shaped bricks, vertical sheet ties being also employed as

therein set forth. When I make a construction of this sort I form the sheet ties with openings for the shoulders of the bricks to go through, where they join each other in forming a continuous pipe or tube, the cross ties for laterally binding them together crossing over or under the pipe opening, or both over and under where two ties are employed.

In this construction I also under some circumstances make use of interior thin metal pipes like "stove piping," which I insert in the hollow brick. These metal pipes are made to fit the hollow "collar brick" very snugly, and are cemented therein so as to become a part of them, thereby giving great strength to the continuousness of the pipes, and thus to the floor made of them.

By a modification of this plan I make a floor precisely as here described, except that the bricks are left out and carbonite, concrete, cement, "beton coignet," or other equivalent material used in lieu of the baked bricks, which materials may be either moulded and used in block form like brick, or used in plastic form, and in this state moulded directly upon the tubes and rods in situ. By a modification of the "collar brick" (leaving out one side) it becomes a trough brick. These trough bricks I make especially for roofs, setting them with glass where light is wanted in the roof. I also propose to employ them for floors but naturally in a reversed position, the bottom of the bricks being uppermost to form a walking surface; for greater strength under such circumstance I sometimes make the trough brick with two additional sides, which converts it into an

open box; the added sides serve a cross braces between the iron rods or rails on which the bricks are supported. Where I form a floor of trough bricks with the open sides upwards I sometimes fill the troughs with concrete, and level off for the surface flooring. In other cases I overlay them with flat tiles, which when closely cemented convert the troughs into hollow passages that may be turned to account after the manner of the old Roman "hypercausts." By another modification in the form of a trough or U brick it may be converted into an H or double trough brick, a gutter being formed upon both the upper and under sides. In this form floors and walls may be made by enclosing the troughs so as to produce a double layer of hollow pipes, one set of which may be employed to heat the building, and the other to ventilate it; the warmth upon one side of the partition between the two ranges of flues serving to accelerate the passage of the air by a slight rarefaction of it. In all cases of enclosing tie rods in hollow bricks I prefer to first surround the tie with plaster of Paris fiberized with asbestos.

According to another part of my Invention I make fireproof roof lights of stamped or pressed sheets of metal to be used for the purposes of this my Invention, the peculiarity of which consists in obtaining the best distribution of light by the manner of arranging the corrugations.

By the method now devised by me I stamp or press sheet metal so as to produce an interlaced system of welts or ribs upon one face thereof and gutters or depressions corresponding thereto upon

the other side, the spaces enclosed by the welts or ribs being hexagonal, or in effect hexagonal (for they might be circular and still occupy hexagonal divisions) in shape; these spaces I perforate and set with glass for giving light. This form of metal when set with glass affords the maximum of strength and light with the least expense of metal. A part of this improvement, which however is of a general nature, is in the glass.

As hitherto made the glasses used for "illuminating gratings" have been either made from plate glass or pressed for the purpose in moulds of their own. All these glasses are comparatively thick, and thick glass for resisting flame is inferior to thin.

My improvement consists in closing the apertures of illuminating gratings with blow glass, which may be much thinner than it is possible to press or roll it, and being thin a cheaper quality of glass transmits a better light than if thicker and made by pressure. I also make these glasses in the nature of hollow spheres or partial spheres for greater strength in connection with their lightness; in some cases I make these hollow glasses with closed bottoms to confine a body of air within to prevent "sweating;" and to make them as fireproof as possible I also in some cases incorporate a wire netting or mesh made in hollow spherical form to fit the shape of the glass, the globular wire netting or mesh is place in the mould and the glass blow in upon it, thus incorporating the one within the body of the other.

According to another part of my Invention for making fireproof glass I make plate or rolled glass

with a netting of wire incorporated in the body of the plate, one mode of doing this being as follows:— I use two drums or rollers, as is done sometimes in making ornamental face glass, one behind the other. The former carries a wrap or web of wire netting, which as it rolls down the "metal" is spread out upon the face of te flattened mass; but this "metal" is only half of what is needed to make the sheet. Another dumping of another mass is made immediately upon the first flattened sheet with its overlaying of wire netting, the second mass falling upon the wire netting, where it is met by the 2nd or following roller and flattened out, thus incorporating the wire sheet between two plates of glass welded together.

A part of my improvement in connection with the use of this fireproof plate glass is a method of cheaply applying it to use, this method however being also applicable to other plate or sheet glass. According to the method in common use a frame to contain a number of panes of glass is made in every instance, which involves an expense for special measurements, and is hence fatal to any plan for keeping the article "in stock" or ready to be applied anywhere and by anybody. By my method no such frame is required, each pane of glass whatever its length is set in its own frame or "chase." The chase upon one of its long slides has a tongue like a matched floor plank, and upon the other a groove to correspond, so that when two or more are placed side by side and pressed together with any suitable cement or mastic between them a water-tight joint is made, and any stretch of work over any sized opening may

be readily laid by even an unskilled workman.

For some purposes instead of a complete tongue and groove. I form the chase upon what may be called the half tongue and groove system, a lip or under rest being formed along one long edge or side of the chase and another or over rest is formed upon the opposite side of the chase, so that when two are brought together one takes a bearing upon the other; in this construction I prefer to use light wire cross-tie rods to bind the panels laterally together.

According to another part of my Invention having reference to beams I make an open bottomed or half tubular beam of sheet metal, which I bend into an arch with straight sides, and to each side near the bottom edge I rivet a flat tie, leaving sufficient metal below the tie for a range of holes or of countersinks for the reception of cross tubes, as hereinabove described.

According to another part of my Invention having reference to ventilation and protection against fire in connection with illumination, and which specially applies to ships, I make an illuminating grating (preferably of lignum vitae, or other hard and tough wood, because it does not rust) in two parts or layers, and upper or outer and an under or inner one, the latter containing the glasses. In applying these ventilating lights to ships one grating, that in which the glasses are not set, is fixed permanently in the deck, the other, which contains the glasses, is moveable and attached to the under side of the former. In moving it slides back and forth, bodily carrying the glasses with it into and out of the open-

ings in the permanent grating, so as to either open or close them, each glass being fitted with an elastic collar, and the holes in the permanent grating being tapering, the largest end being on the under side. By this arrangement the glasses are always under the open holes of the fixed rating when they are not in them, which thus not only affords protection against any objects, such as lighted matches and burning cinders falling through the opeings into the cabin below, but also prevents any one there from looking upward under the petticoats of the ladies.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Thaddeus Hyatt in the Great Seal Patent Office on the 12th November, 1874.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, THADDEUS HYATT, of Gloucester Gardens, Hyde Park, in the County of Middlesex, Manufacturer of Patent Lights, send greeting.

WHEREAS, Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Fourteenth day of May, in the year of our Lord One thousand eight hundred and seventy-four, in the thirty-seventh year of Her reign, did, for Herself, Her heirs and successors give and grant unto me, the said Thaddeus Hyatt, Her special license that I, the said Thaddeus Hyatt, my executors, administrators, and assigns, or such others as I, the said

Thaddeus Hyatt, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "Improvements in constructing, lighting, ventilating and fire-proofing buildings partly applicable to building materials and appliances, and to ships," upon the condition (amongst others) that I the said Thaddeus Hyatt, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

Now Know Ye that I the said Thaddeus Hyatt, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:—

My said Invention relates to improvements in constructing, lighting, ventilating, and fireproofing buildings, partly applicable to building materials and appliances, and to ships; and consists according to one part thereof in making beams of interlaced metal as a convenient means for not only holding concrete or other equivalent material in form when

under the strain of a load, but also as a convenient means of securely uniting a wrought-iron tie or resister to tensile strain to a beam of earthy, stony, or other equivalent material under resistance to a crushing strain; the crushing material and the metal tie forming the actual beam, although any amount additional strength may be put into the interlaced parts if desired. In carrying into effect this part of my Invention I braid or unite metal strips, ribbons, or wire, so as to form hollow tubes, illustrated on Sheet 1 of the annexed Drawings, by Figures 1 and 2, which tubes may be employed in cylindrical form, as shown by Figures 1 and 2, or the cylinders may be drawn through suitable shaping dies or otherwise manipulated until made to represent the forms of ordinary solid beams, such as the web and flange, the U shape, or other forms, as shewn by Figure 3.

a, a, Figures 1, 2 and 3, represent the interlaced metal and *b, b,* the concrete or other equivalent material. Figure 2 represents a beam made of two shells or skeletons of interlaced material and outer one *a, a,* and an inner one *a', a',* both imbedded in the concrete *b, b.* This beam as represented in Figure 2, is hollow but may be solid if preferred. The tie *c* may be rivetted or otherwise attached to the metal skeleton, as shewn, and is preferably placed well up in the concrete to be out of the way of flame in case of being attacked by fire.

Figures 4 and 5 represent the metal skeleton *a, a,* in the form of a spiral made of flat metal ribbon, the tie-rod C being attached to the bottom thereof on the inside as shewn, *b, b,* being the concrete plas-

tie or cement. This spiral coil may, if desired, have wire netting added to it, or longitudinal strips of metal somewhat similar in shape to the tie placed along its sides and top, and fastened thereto as an additional hold to the concrete.

According to another part of my Invention I make the metal skeleton of sheet metal by first cutting it with slits *d, d,* Figures 6, Sheet 2; *e, e,* being the uncut parts of the sheet. I then pull out *e, e,* in opposite directions from each side of the sheet and thereby obtain tubular forms, as shewn by Figures 7, 8, 9 and 10; *e, e,* being the metal; *f, f,* Figure 8, being the concrete; and *c, c,* being the tie-rod.

According to another part of my Invention I make tubular beams of solid sheet metal and tie rods, employing in some cases metal sufficiently heavy to form a material portion of the strength of the beams, and in others to merely serve the purpose of the skeleton beams above described, viz., to unit the tie to the earthy or stony portion of the beam. Figures 11 and 12 represent this form, each being made, as here shewn, of two cylindrical metal shells or tubes, an outer one *a, a,* and an inner one *a'*, *a'*, *c, c,* being the tie rod, and *f, f,* the concrete. The cylinders are concentric in Figure 11, but excentric to one another in Figure 12.

According to another part of my Invention I make floors, roofs, and other constructions of metal beams arranged to be readily connected together laterally with tubes placed between them which serve the purpose of distance pieces, and which are likewise bound together by rods which run through the whole and

are tightened up by nuts at their ends. Figure 13 illustrates this part of my Invention in plan. A, A, A, being three beams placed parallel to each other, *g, g, g,* representing the web of the beams. These webs are provided with protections *h, h,* to receive the ends of the tubes or distance pieces *i, i,* through which pass te rods *k, k,* furnished with nuts *l, l,* to tighten the whole. By using two ranges or layers of these tubes, one at the top and another at the bottom, and imbedding them in plaster of Paris, concrete, or other fireproofing material, a hollow fireproof floor or other construction may be made both light and strong. Figure 14 represents a method of attaching a layer of such tubes to the under side of any number of ordinary web and flange beams, A, A, being the beams, and A', A', the attachment. These attachments may be made of light sheet metal, *h, h,* being the projections on the web *g, g,* of the attachment to receive the distance pieces, *i, i,* and the tightening rods *k, k.*

When an attachment of this description is applied to the lower flanges of beams which make a floor, as shown by Figure 14, part of my Invention consists in forming it of metal sufficiently strong to hold a solid body of plaster of Paris or other fire-proof plastic, which encasing the whole and forming a ceiling to the room below. and at the same time completely protecting the lower flanges (the vulnerable parts of the iron beams) against fire, also enables me to protect the web portions of the beams A, A, by a coating of plaster of Paris, concrete, or equivalent material, which may rest upon the solid fire-

proof ceiling below, and be formed up oven-fashion against the beams on either hand and at top so as to make longitudinal hollow spaces or flues between them. In this way I make light fire-proof floors, which may be described as hollow concrete floors carrying a series of parallel beams with the solid portions of the concrete between the spaces.

Figure 15 represents a construction like that shewn by Figure 13, but set with the glasses *m, m,* in apertures formed in the plaster or plastic material *f, f,* between the metal parts of the construction which may be employed to give light through and form illuminating fireproof roofs, floors, partitions, and other parts of buildings and footways.

According to another part of my Invention for constructing fireproof floors, roofs, and walking surfaces of earthy or stony material to receive the crushing strain in combination with tie rods to resist the tensile strain, I arrange the tie rod in such combinations with the earthy or stony material as to compel it to act simultaneously with it under the influence of a load. To do this the tie must get a hold upon the upper part of the earthly material, whether this material be in the form of concrete, moulded beton, artificial stone, baked or other bricks, or otherwise, in order to avoid breaking out from the bottom of the floor when the strain comes.

According to one method of effecting this purpose where the floor is made of concrete or other plastic material I use an upper and under rail of metal, the lower one being the tie, and connect the two together by vertical metal connections in the shape of hooked

wires or rods, or in the shape of sheets of metal, which may be termed vertical sheet ties. These sheet ties may be of sufficient width to connect any number of parallel rails and ties. In making floors the metal parts are placed first in position over a suitable platform, the concrete is then thrown in, levelled off, and left to set and harden, and the floor is made.

Figure 16, 17 and 18, on Sheet Three, represent such a floor as made of bricks, a peculiarity of which, and which constitutes a part of my Invention, consists in forming the bricks with open slots *r, r,* Figure 17, at the bottom of the brick in order to connect them readily with the tie rods *p, p,* as shown in Figure 18, where also the crooked or hooked rod of iron *v,* heretofore mentioned, shews the manner of holding the rod to the upper part of the brick when sheet vertical ties are not employed. The vertical sheet ties are shewn in Figure 16, at *n, n,* in a corrugated form, but in Figure 18 they are represented as flat. The upper rail is indicated by the letter *o.* This rail may be dispensed with when hooked rods *v* are employed. *q, q,* are holes formed through the brick *s, s,* Figure 17, and constitutes in combination with the thin formation of my brick a part of my Invention.

Figure 17 represests one of my bricks of full size and proportions. With such bricks I construct floors upon the theory that the cement used to bind the bricks together is the main element of the floor, as if a plastic mass were laid, poured, or spread out in quantity sufficient to form a whole floor, and then while still soft the bricks were forced down into it all over the surface and placed at about a half inch

apart. In such a procedure and with such bricks as mine the cement would form the continuous part of the structure connecting itself as it would do around the sides of all the bricks, and through them by means of the holes, and the bricks made spreading like flat roofing tiles, instead of being thick and compact like ordinary building brick would present a proportionately larger area of surface for combining with the cement than do ordinary brick. Floors and roofs of limited span, or made for no great load, may be even constructed thus without ties or any metal whatever, providing good cement be used and sufficient time be given the parts to harden and perfectly unite, for the entire floor, if properly made, will then have become and be precisely like one large slab or stone for strength. The open slots at the bottom of the brick, as seen at r', r', Figure 17, are half slots, as are the holes q', q', half holes, and are made so in order that where two bricks come together edge to edge there may be complete openings, as in the bricks themselves.

In some cases I make the bricks wedge shaped for special constructions, one course of bricks being wedge shaped lengthwise of the bricks, and the following course wedge shaped crosswise of the bricks, tie rods and vertical ties or hooked rods being used with them, as described.

In still other cases and for the purpose of constructing a floor or roof of less weight I make the bricks with a large central opening, or where I desire to unite them on the break-joint plan I make each brick with two half holes back to back. These

bricks when laid together form floors with horizontal parallel flues running through the body of the floor, which may be utilized as hot-air flues or otherwise for convenience of heating and ventilation or for other purposes. By surrounding these holes with rings made like collars they may be joined in a similar manner to connecting joints of stove pipe, or according to a variation of the method thin metal pipes like stove pipe may be employed to give strength to the floors, and with or without tie rods, the metal pipes being inserted into the holes or flues of the bricks described. Still other modifications, but all based on the essential principles of the constructions herein set forth, may be made, but are not necessary to further describe.

According to another part of my Invention, and which relates to fireproofing the light transmitting parts of buildings, I make sheet and plate glass with a wire netting in the glass by providing a suitable sheet of wire netting and placing it upon the casting table when the "metal" is about to be poured out upon it to form the sheet or plate of glass. Figure 19 on Sheet 4 represents such a plate of glass one inch thick, two feet wide, and ten feet long. The wire netting *w* is composed of meshes one and a half inches in size, the diameter of the wire being about one-eighth of an inch. On the under side rods *x*, *x*, of wire, three-sixteenths or one quarter of an inch thick, are fastened at about a foot apart for the purpose of keeing the sheet of wire up from the face of the casting table, and thus enabling the "metal" to

get to the under side of and enclose the netting within the body of the glass.

According to another part of my Invention relating to the construction of the illuminating parts of buildings I cheapen the method of construction where glass in plates or sheets are employed by setting each plate, plane, or sheet in its own chase, as shewn by Figures 20, 21, 22 and 23. Figure 20 represents a metal chase formed with a seat *a, a,* to receive the glass. Upon one side this chase is formed with a tongue, indicated by Figure 1, small, and upon the other it is formed with a groove, indicated by Figure 2, small. Figure 21 shows the manner of uniting such chases after the method of matched floor plank. Figures 22, 23, shew the same, except that in place of a complete tongue and groove half tongues and grooves or a lip and a lap are employed. These chases I also in some cases provide with a wire netting diaphragm in accordance with my former Patents for making safe walking surfaces.

According to another part of my Invention I make ventilating illuminators specially adapted for the decks of vessels, as shewn by Figure 24, where A, A, is a movable plate set with tapering glasses C, C, and B, B, is a fixed plate attached to the vessel's deck, H, H; the fixed plate has tapering light holes D, D, lined with india-rubber gaskets indicated by 4, 4. It has also a stem E cut with a screw thread, upon which in connection with the short rods G, G, attached to the fixed plate the movable plate A, A, slides back and forth when it is desired to open or close the light holes D, D. The movement of the ad-

justable plate A, A, is controlled by the screw nut F, which on drawing the plates together forces the tapering glasses C, C, into the tapering light holes D, D, against the india-rubber gaskets 4, 4, and thus makes a water-tight joint. These ventilating illuminators may also be applied to roofs and to floors and walking surfaces, also as port lights in ships, and in other situations were a ready means of obtaining ventilation is required with protection against the intrusion of water.

Having now described and particularly ascertained the nature of the said Invention, and the manner in which the same is or may be used or carried into effect, I would observe in conclusion that what I consider to be novel and original and therefore claim as the Invention secured to me by the herein-before in part recited Letters Patent is,—

First. Making hollow metal beams of interlaced lattice or openwork, as the holder of a tie rod, to connect the same with concrete or equivalent material, substantially as and for the purposes herein set forth and illustrated by Figures 1, 2, 3, 4 and 5 on Sheet One of my Drawings.

Second. Making hollow metal beams or slitted sheet metal, as the holder of tie rods, to connect the same with concrete or equivalent material, substantially as and for the purposes herein set forth and illustrated by Figures 6, 7, 8, 9 and 10 on Sheet Two of my Drawings.

Third. Making hollow metal beams of sheet or plate metal, substantially as and for the purposes

herein set forth and illustrated by Figures 11 and 12 on Sheet Two of my Drawings.

Fourth. Making floors and roofs of beams and attachments, and floors, roofs, partitions, and walking surface of beams, tubes and tightening rods connected with each other and combined with concrete, plaster, or other equivalent fireproofing material, substantially as and for the purposes as herein set forth and illustrated by Figures 13, 14 and 15 on Sheet 2 of my Drawings.

Fifth. Making floors, roofs, and walking surfaces of bricks shaped, combined, and held together substantially as and for the purposes as hereinset forth and illustrated by Figures 16, 17 and 18 on Sheet 3 of my Drawings.

Sixth. Making thin or tile-shaped brick, and forming them with open bottom slots for ready application to tie rods, substantially as and for the purposes herein described and illustrated by Figures 16, 17 and 18 on Sheet 3 of my Drawings.

Seventh. Connecting the tie rods of floors, roofs, and walking surfaces made of bricks, as set forth in Claim Sixth, with the brick portion thereof by means of vertical sheet ties or by means of hooked rods, substantially as herein set forth and illustrated by Figures 16, 17 and 18 on Sheet 3 of my Drawings.

Eighth. Making sheet and plate glass by combining wire netting with the "metal" upon the casting table, substantially as and for the purposes herein described and illustrated by Figure 19 on Sheet 4 of my Drawings.

Ninth. Combining sheets, panes, or plates of

glass with tongue and groove chases, substantially as and for the purposes herein described and illustrated by Figures 20, 21, 22 and 23 on Sheet 4 of my Drawings.

Tenth. Making ventilating illuminators composed of two plates, the light holes of the upper plate being tapering and lined with india-rubber or its equivalent, and the glasses taking their bearings in the lower plate, substantially as herein described and illustrated by Figure 24 on Sheet 4 of my Drawings.

Eleventh. Combining with ventilating illuminators, as set forth in Claim Ten, the screw shank E steadying pins G, and adjusting nut F, or their equivalents, substantially as and for the purposes herein set forth and illustrated by Figure 24 on Sheet 4 of my Drawings.

In witness whereof, I, the said Thaddeus Hyatt, have hereunto set my hand and seal, this Tenth day of November, in the year of our Lord One thousand eight hundred and seventy-four.

THADDEUS HYATT. (L. S.)

FIG. 1.

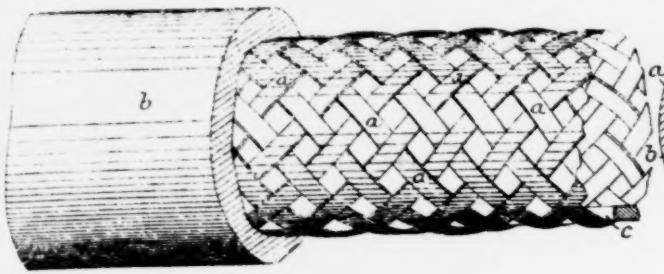


FIG. 2.

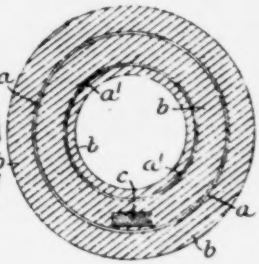


FIG. 3.

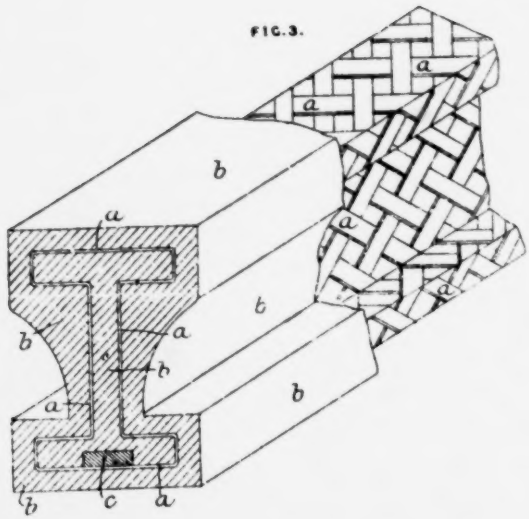


FIG. 4.

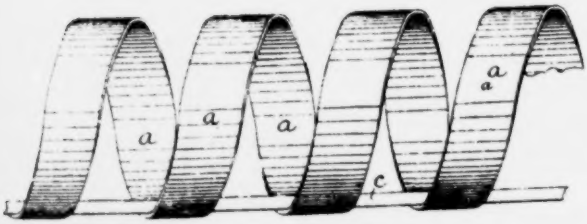
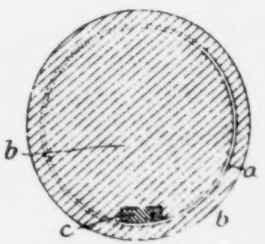


FIG. 5.



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4 SHEETS
SHEET 2

FIG. 6.

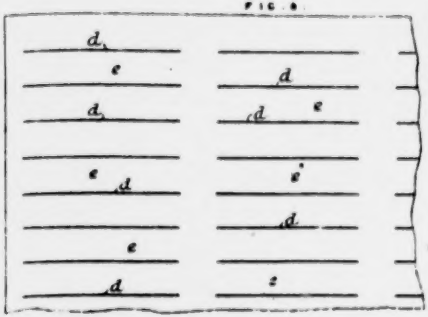

FIG. 8.

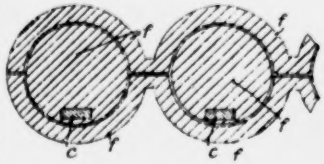

FIG. 9.

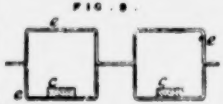

FIG. 13.

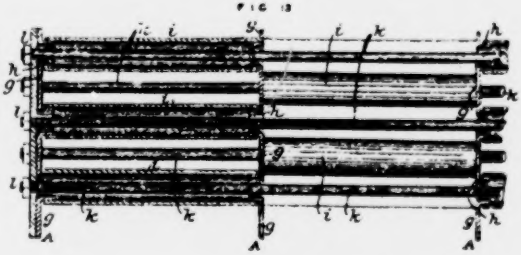

FIG. 7.

FIG. 10.

FIG. 14.

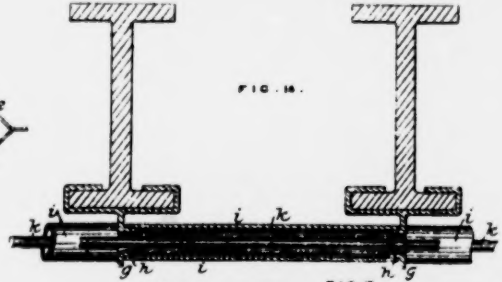

FIG. 12.

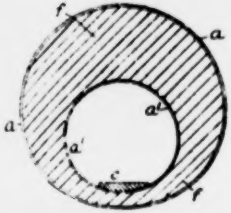

FIG. 11.

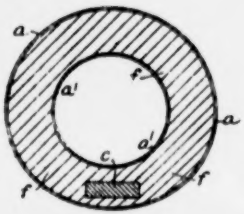

FIG. 15.

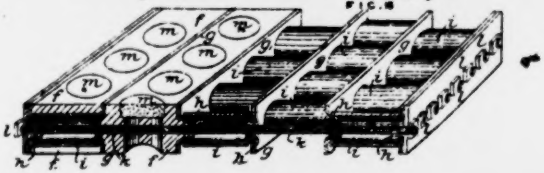

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FIG. 16.

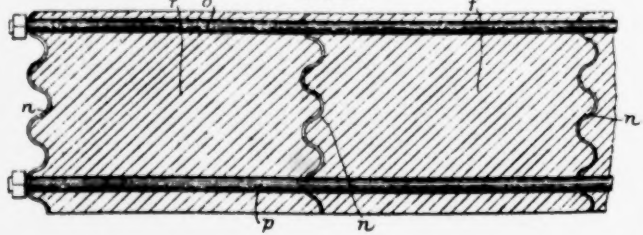


FIG. 17.

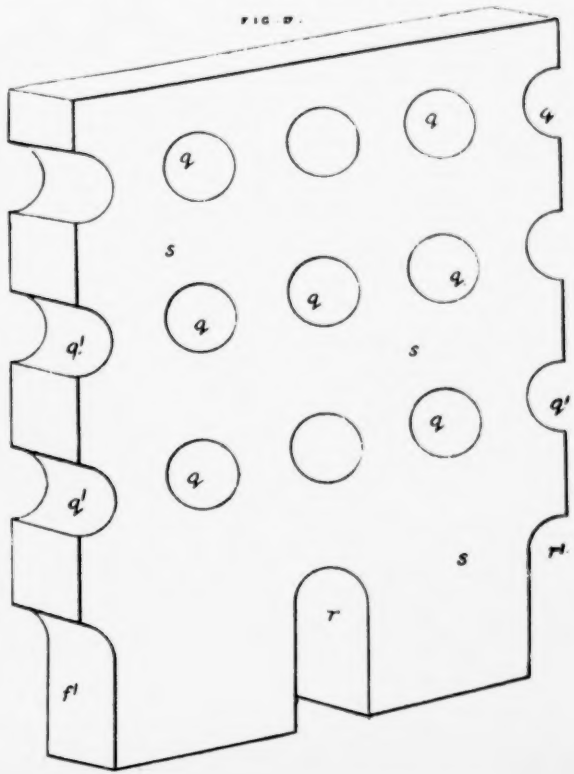
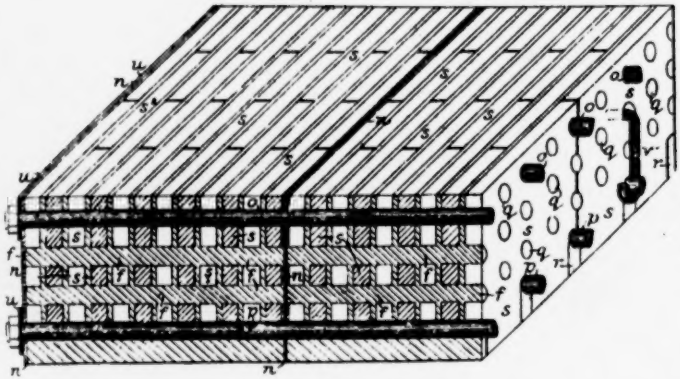


FIG. 18.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SHEET 4.

FIG. 19.

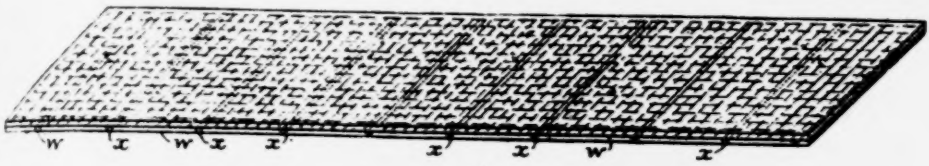


FIG. 21.

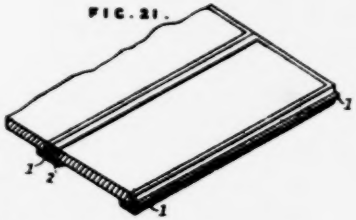


FIG. 20.

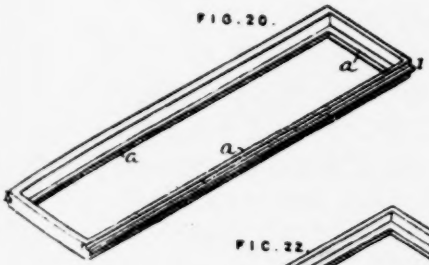


FIG. 23.

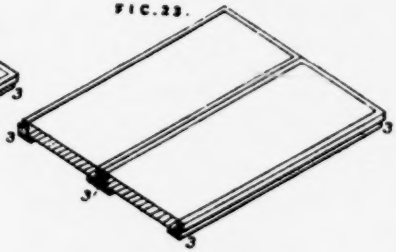


FIG. 22.

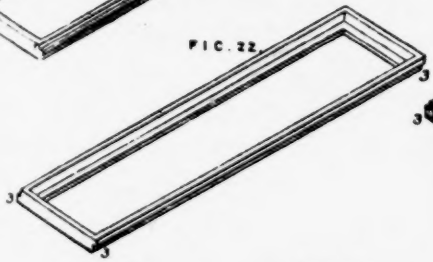
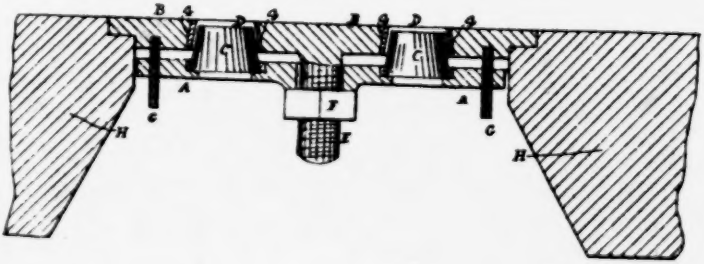


FIG. 24.



The filed drawing is not coloured.

DEFENDANT'S EXHIBIT AA-2.
British Patent 14559 of 1885.

COMPLETE DESCRIPTION

Improvements in the Construction of Fire-Proof Pillars and Columns

We Robert Bristow Lee of 8 Deansgate, Manchester, in the County of Lancaster, Iron Fence Manufacturer, and James Hodgson of Theatre Street, Ulverston in the same County, Colliery Agent do hereby declare the nature of this Invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement and accompanying drawings:—

Our said Invention relates to the pillars and columns used in building and for other purposes and consists in an improved method of construction whereby such pillars and columns can be easily and cheaply produced. In making a fire-proof column according to our invention we use a metallic pillar constructed from spiral coils as described in the Specification of Letters Patent No. 4670 of the year 1881 granted to one of us the said Robert Bristow Lee. The said metallic pillar is formed from spiral coils of flat, round, channel angle or tubular iron or steel rivetted together so as to form a cylinder of open trellis work. The interior of such a cylinder is filled with concrete or other fire-resisting material or compound the outer portion being also coated with a sufficient thickness of the same or a similar concrete or material so as to cover and insulate the metallic trel-

leaving the hollow space *d*. The outer envelope *c* is then applied and the column is complete. Instead of using one metallic trellis work cylinder as described we may use two or more than two such pillars arranged concentrically and sustained in their relative positions by ties or supports extending from one to the other. We might also form columns of a triangular square or polygonal instead of a round section, the metallic trellis work skelton being either cylindrical or square of polygonal as desired. In cases where it is found to be necessary provision may be made for expansion and contraction of the column under varying degrees of temperature.

Having now particularly described and ascertained the nature of our said Invention and in what manner the same is to be performed we declare that what we claim is

In the manufacture of fire- proof columns the employment of one or more spirally coiled metallic trellis-work cylinder or cylinders or structure or structures of a round, square triangular or polygonal form and acting as a skelton within and upon or around which concrete or other fire-resisting or suitable material or compound is placed or applied the outer surface being preferably made capable of being treated, decoratively if desired and the whole forming a fire proof column substantially as hereinbefore described and illustrated in the accompanying sheet of drawings.

Dated this 10th day of June, 1886.

DUTTON & FULTON,
Agents.

FIG. 1.

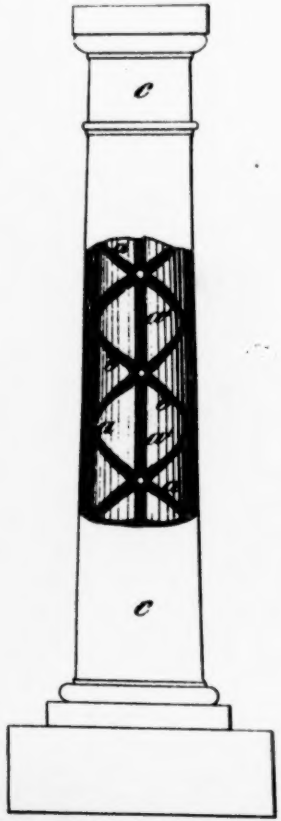


FIG. 2.

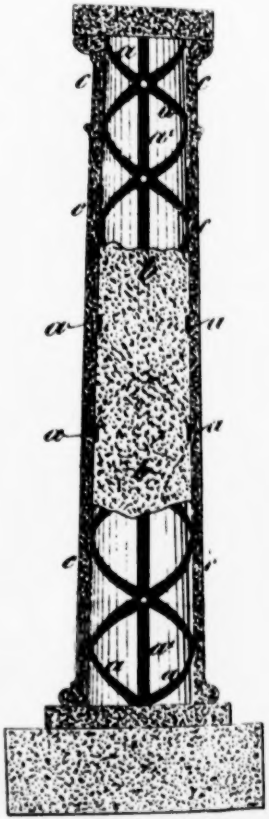


FIG. 4.

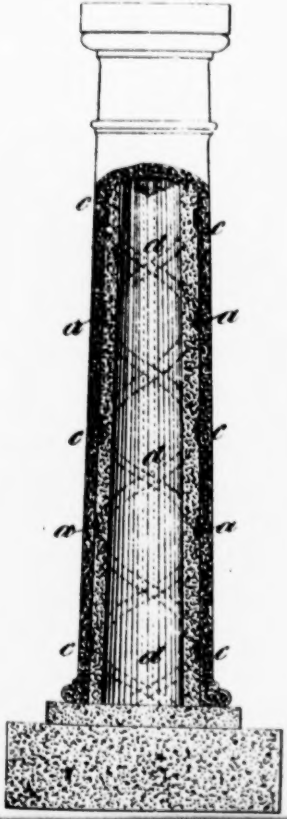


FIG. 3.

FIG. 5.

DEFENDANT'S EXHIBIT AA-3
British Patent.

No. 20,675—A. D. 1902.

Date of Application, 22nd Sept., 1902—Accepted, 27th, Nov., 1902

COMPLETE SPECIFICATION.

Improvements in or Relating to Piles and the Like

I, Maurice Dumas, Engineer, of 6 Rue Watteeu, Brussels, Belgium, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to a pile and the like and consists of a combined metal and armored cement structure.

The pile comprises essentially an iron or steel casing having the necessary exterior shape which is to be given to the pile, with a filling of beton in which a hollow space is formed, and an interior armor or reinforcement entirely enclosed in the beton and which may be of iron or steel.

The object of such a construction is two-fold; *viz*:

1. To constitute a pile, which, by means of the interior armored cement and the casing may have all the necessary resistance to withstand the strains to which it will be subjected.

2. To obtain by means of the mere resistance of the cement and of the interior army, a solid body of armored cement having all the necessary solidity

and strength, in such a way that if, subsequently, the exerior casing should disappear or become weakened by the action of the water of any substances whatever contained in the water or the ground, in which the pile is inserted, the beton or the interior armature, which themselves are unalterable, are sufficient to secure the stability of the construction.

The exterior casing will be constituted by solid sheet iron, the joining of the meting edges of which may be effected by any means such as rivetting, welding, folding, *etc.*:

The inner armour, parallel and concentric with the outer casing, will be constituted either by round or flat bars or irons arranged in lattice fashion parallel with the direction and generatrix of the cylindrical surface of the pile, or by a perforated or solid sheet iron likewise parallel with the outer caslng.

The filling with beton and the hollow space in the body of the beton may be effected in any suitable manner and the hollow may be of any form which may be found convenient.

This hollow, which is provided in order to reduce the weight of the pile in case of large piles or when the diameter of the pile is relatively large, or from any other reason, is optional, so that the cement filling may be solid.

The piles may be of any desired shape which may be convenient for particular cases and may be driven into the ground by any means.

There may be moreover provided with suitable shoes or parts to enable them to be utilized as screw-piles.

In the annexed drawings is represented, as an example, a round pile adapted to be driven into the ground.

Figure 1 is a vertical section on the line A—B of Figure 2 of a pile with a hollow filling;

Figure 2 is a horizontal section on the line C—D of Figure 1;

Figure 3 is a vertical section on the line E—F of Figure 4 of a pile with a solid filling.

Figure 4 is a horizontal section on the line G—H of Figure 3.

The body of the pile (Figure 1 and 2) is constituted by a sheet iron tube or casing 1, in which is introduced a beton-cement filling 2 having a hollow 3 in body of the cement and an armor 4 formed by round vertical bars and horizontal rings or windings likewise of round iron.

Above the hollow part 3 is a solid part or cover to resist the blows when the pile is being driven in.

The point of the pile is provided with a conical sheet iron shoe 5 having a cast or iron point 6. The outer tube 1 extends above the cement filling so as to form a cavity into which the driving block 7 may strike, an intermediate filling 8 of any suitable material such as felt, sawdust, caoutchouc, *etc.*, acting as a buffer to take up the shock of the sudden impacts and to distribute the force equally over the pile.

In the Figures 3 and 4 the hollow is suppressed, the other parts remaining the same as in the first described pile.

Having now particularly described and ascertained the nature of my said invention, and in what manner

the same is to be performed, I declare that what I claim is:—

1. A pile comprising a metal casing with a filling of armored cement which may be hollow or solid this filling having embedded in it an armor of vertical metallic bars and horizontal rings or windings the pile being provided with a point at its lower end and having at its upper end a cavity formed by the casing extending up beyond the cement and in which is preferably provided a charge of felt, sawdust, caoutchouc or the like substantially as described.

2. The complete pile substantially as described or illustrated in Figures 1 and 2, or in Figures 3 and 4 of the accompanying drawings.

Dated this 22nd day of September, 1902.

BOULT, WADE & KILBURN,
Agents for the Applicant.

This Drawing is a reproduction of the Original on reduced scale.

Fig. 1. (AB).

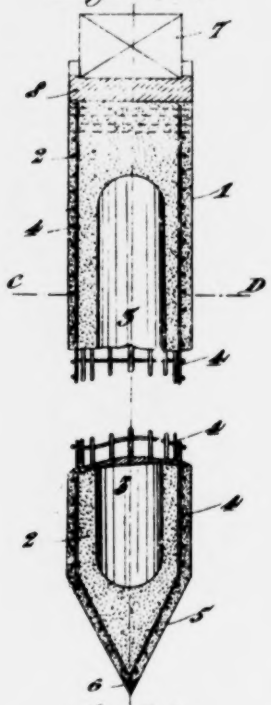


Fig. 2 (CD)

Fig. 3. (EF).

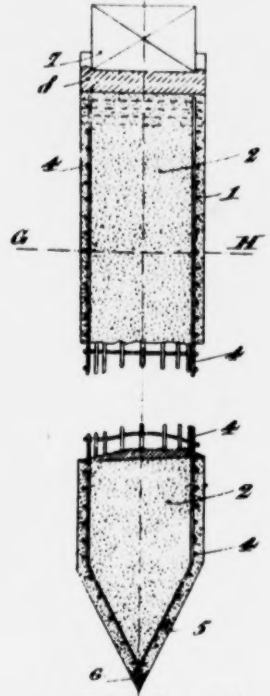


Fig. 4. (GH).

DEFENDANT'S EXHIBIT AA-4.
British Patent.

No. 12,228—A. D. 1893.
Date of Application, 21st June, 1893
Complete Specification Left, 5th Mar., 1894—
Accepted, 7th Apr., 1894.

PROVISIONAL SPECIFICATION.

Improvements in Metallic Sheathing or Coverings for Columns and Other Structural Parts of Buildings.

I, Thomas Lewis Banks, of Holmrook, Cumebrland, F. R. I. B. A. do hereby declare the nature of this invention to be as follows:

Columns and other structural parts of buildings, whether of wood or metal, are frequently covered with metal lathing for the reception of a plaster coating, such as expanded metal, for which purpose there are fixed upon the surface of the column, or other structure, strips of wood, to which the metal lathing is then secured for receiving a coating of plaster. This construction has the disadvantages firstly of the metal lathing being in direct contact with the wood strips, and secondly that considerable labour is expended firstly in fixing the wood strips on the column, &c., and secondly in fixing the metal sheathing on the wood strips.

According to my present invention I dispense with the use of such wood strips and also greatly lessen the labour of fixing the said coverings on the columns, &c.

For this purpose I fix upon the surface of the expanded metal or metal lathing which is to come next the column, &c., longitudinal metal distance pieces, projecting to an extent from the surface of the lathing corresponding to the distance which the lathing is required to be away from the surface of the column, &c.

The lathing thus prepared, then simply requires to be laid upon the surface to be covered, so that the projecting distance pieces bear against the said surface, the metal lathing being then secured in this position by any suitable means, such as, in the case of columns, by merely drawing the edges of the lathing close together and securing them in that position.

For the said distance pieces I prefer to employ strips of thin metal bent to form a cross section of U or V shape with flanges at the edges, and I secure such strips with their flanged side against the lathing, the flanges being slit so that portions thereof can be bent around the meshes of the lathing in order to securely fix the strips thereto.

This construction of the distance pieces has the advantage of affording a certain amount of elasticity so that when the lathing is laid round the column with a certain amount of pressure, the distance pieces will be somewhat compressed, so that on releasing the lathing from the external pressure after fixing it, the elastic grip exercised by the distance pieces upon the column will hold the lathing securely in position.

Dated this 21st day of June, 1893.

ABEL & IMRAY,
Agents for the Applicant.

COMPLETE SPECIFICATION.

Improvements in Metallic Sheathing or Coverings for Columns and Other Structural Parts of Buildings.

I, Thomas Lewis Banks, of Holmrook, Cumberland, F. R. I. B. A., do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertainedby the following statement:—

Columns, walls and other structural parts of buildings whether of wood or metal, are frequently covered with metal lathing for the reception of a plaster coating, for which purpose there are fixed upon the surface of the column, or other structure, strips of wood, to which the metal lathing is then secured for receiving a coating of plaster. This construction has the advantages firstly of the metal lathing being in direct contact with the wood strips, and secondly that considerable labour is expended both in fixing the wood strips on the columns, &c., and in fixing the metal sheathing on the wood strips.

According to my present invention I dispense with the use of such wood strips and also greatly lessen the labour of fixing the said covering on the columns, &c. For this purpose I fix upon the surface of the metal lathing which is to come next the column, &c., longitudinal metal distance pieces projecting to an extent from the surface of the lathing corresponding to the distance which the lathing is required to be away from the surface of the column, &c. The lathing thus prepared, then simply requires

to be laid upon the surface to be covered, so that the projecting distance pieces bear against the said surface, the metal lathing being then secured in this position by any suitable means, such as, in the case of columns, by merely drawing the edges of the lathing close together and securing them in that position.

For the said distance pieces I prefer to employ strips of thin metal bent to form a cross section of U, V or other shape with flanges at the edges, and I secure such strips with their flanged side against the lathing, the flanges being slit so that portions thereof can be bent round the meshes of the lathing in order to securely fix the strips thereto. This construction of the distance pieces has the advantage of affording a certain amount of elasticity so that when the lathing is laid round the column with a certain amount of pressure, the distance pieces will be somewhat compressed, so that on releasing the lathing from the external pressure after fixing it, the elastic grip exercised by the distance pieces upon the column will hold the lathing securely in position. When employing this construction for covering flat walls, the said flanged metal distance pieces are more conveniently fixed by nails or screws to the wall in the first instance, and after the metal lathing has been laid upon them, slit portions of the flanges are bent round the meshes of the lathing so as to secure it in position.

Fig. 1 of the accompanying drawings shows part of a column covered with metal lathing according to my above described invention. Fig 2 shews a cross section. Fig. 3 shews the metal lathing A pre-

pared with the metal distance pieces B secured thereto previous to its application to the column. When thus prepared it is laid round the column as at Figs. 1 and 2, and the meeting edges are drawn tight and secured by lacing wire or other fastenings, the elastic nature of the distance pieces enabling them to be slightly compressed so as to insure a perfectly tight fixture of the lathing, upon which is then laid the plaster covering C. Thus the metal lathing with its plaster covering will constitute a fire-proof sheathing to the column secured at a distance from its surface and thus affording a very effectual protection to the latter against fire. The distance pieces B may either be of the V form shewn at Fig. 4, or of the U form shewn at Fig. 5 or of the Z form shewn at Fig. 6, the flanges *b* being slit in any convenient manner as at *b'*, *b'*, and bent round the metal lathing. This is by preference formed of interlaced twisted metal strips. Fig. 7 shews my invention applied to the fixing of metal lathing to a wall; the distance pieces B, B, are in this case fixed to the wall by nails in the first instance, and the lathing A is then secured to them in the above described manner for receiving the plaster covering C.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In metalic sheathing or covering for columns, walls and other structural parts of buildings, the use in combination with metal lathing, of metal distance pieces secured thereto in such manner as to

keep the lathing a certain distance from the surface to which it is attached.

2. Constructing metal distance pieces such as are referred to in the preceding claim of a V, U, Z, or other flanged section the flanges being slit for affording means of securing the lathing thereto, substantially as described.

Dated this 5th day of March, 1894.

ABEL & IRMAY,
Agents for the Applicant.

Fig. 1.

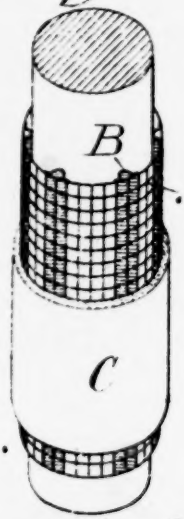


Fig. 4.

Fig. 5.

Fig. 2.

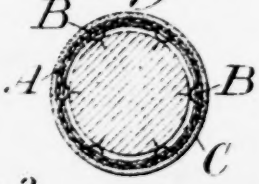


Fig. 3.

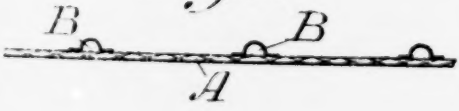
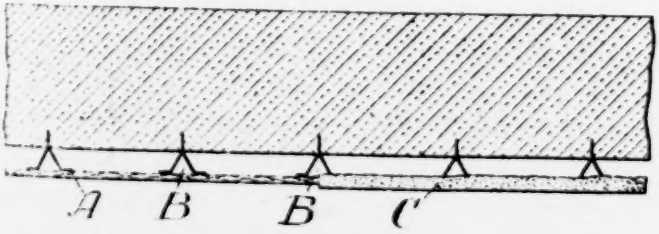


Fig. 6.

Fig. 7.



[This Drawing is a reproduction of the Original on a reduced scale]

London: Printed for Darling and Son Ltd.
for Her Majesty's Stationery Office. 1894.

Malby & Sons, Photo-Lith.

DEFENDANT'S EXHIBIT AA-5.

British Patent.

No. 24,371—A. D. 1904.

Date of Application, 10th Nov., 1904—Accepted, 12th Jan., 1905

COMPLETE SPECIFICATION.

"Improvements in and Connected with Reinforced or Armoured Concrete Construction."

I, Edmond Coignet, of 20, Rue de Londres, Paris, France, Armoured Concrete Constructor, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

This invention relates to reinforced or armoured concrete construction. The general principle governing this kind of construction is to employ the iron reinforcement to resist the tensile stresses and the beton or concrete to resist the compression stresses; and in bodies required to resist flexion it is desirable to leave as much space as possible between the bars which take the tensile stress and the concrete which takes the compression. This rule, however, need not be strictly adhered to in practice, and according to the present invention compression bars as such are also employed to lessen the dead weight, to permit of suitable connection between the tensile and compression parts by metal ties, and to enable beams to be prepared in advance, which after

being placed in position support the centering which bears or supports the fresh concrete as it is laid down, thus assisting in the general resistance of the work.

The use of compression bars, their arrangement and that of the metallic ties substantially as hereinafter described, form the essence of the present invention.

The accompanying drawings illustrate various constructional parts according to the invention.

Figures 1 to 6 are transverse sections illustrating the application to flooring and beams.

Figures 7 to 12 illustrate the application to pillars, columns and pipes.

Figure 13 illustrates the application to a domed roof or arch.

In carrying out the invention according to one mode in the application to flooring and supporting beams thereof as shown in Figure 1 cores are employed preferably consisting of round steel bars, the tensile bars *a* of the beams being connected to the compression bars *b* and therefore to the concrete by means of round iron ties *c*. These ties, bent into U-form, after passing around the tensile bars *a* are twisted by means of pincers, and the ends are bent back to the right and left and thereby connected to the bars *d*, embedded in the under layer of the flooring. The ties are preferably arranged along the beams or ribs at distances increasing as they leave the supports towards the centre of the beams. They may however be arranged obliquely. In cases where the distance between the compression bars and the

tensile bars is excessive, auxiliary longitudinal bars *e* may be used, as shown in Figure 2, the bars *e* being connected to the ties *c*, by annealed iron wire. The bars *e* are only of small diameter as they are only intended to prevent a large area of concrete being left without a core.

When a number of tensile bars *a* are used in a beam, cross pieces *f* may be provided so as to uniformly distribute the stresses over all the bars, as shown in Figure 3.

The plane of the underlayer or flooring connecting the beams or ribs is also reinforced. This is effected in one manner by main bars, *d*, Figures 1 to 3, which rest on the compression bars *b*, of the beams or ribs, but as bent downwards immediately on each side so as to reinforce the lower layer of the flooring as near as possible to the tensile surface.

Additional reinforcement is effected by secondary bars *g*, Figure 4, arranged parallel to the ribs or beams and directly above the main bars *d* which are at right angles to the beams. The primary and secondary bars *d*, *g*, are bound together, where they cross each other, by annealed iron wire.

When there is necessity for a very heavy slab or floor, compression bars *h* and ties *i*, Figures 5, may be employed similarly as before described for the beams. In this case the compression bars *h*, rest on the compression bars *b* of the beams, but they are not inclined or bent but remain parallel to the compression surface of the slab or floor.

The cores being mounted as described in the desired positions for the slab or floor and for the beams,

the concrete or beton is spread or moulded, that for the beams in boxes and that for the floor or slab on centering. Sometimes it is desirable to mould the beams in advance. In such a case the compression bars *b* are arranged tangentially to the upper surface of the beams, the ends of the ties *c*, projecting ready for connection to the main bars *d* of the floor which is to be laid down, as shown in Figure 6. In this case the section of the compression bars ought to be rather strong in order that the reinforced concrete beam made in advance can support the slab or floor and also the centering supporting it. For this purpose suitable holes are made in the beams through which bolts or the like *j*, may be passed to secure planks *k*, for supporting the centering *l*.

The above described method of construction may be applied to plane surfaces whether ribbed or not and capable of resisting flexion, such as floors or retaining walls.

In applying the invention to structures intended to solely resist compression such as pillars, buttresses or arches the arrangements illustrated by Figures 7 to 10 and to 12 are adopted. The pillars, although generally of square section, may be of rectangular or circular section. In the case of one of square section as shown in cross sectional plan in Figure 7, the core or reinforcement comprises four round bars *m*, held apart by thinner bars *n*, to which they are tied by annealed wire. The bars *m*, are situated in the corners or angles. Sometimes four or other number of intermediate longitudinal bars *o*

of small diameter may be used for supporting the beton or concrete between the principal bars.

For pillars of circular section and more especially for reinforced concrete piles the ties *m*, are circular, forming open rings the ends of which are bent back so as to hook automatically and successively onto two main neighbouring bars *m*, as shown in Figure 8 which shows in elevation, plan and detail enlarged plan the reinforcement employment. The arrangement is such that all the longitudinal bars *m*, are interlocked in this manner, the bars being in the example shown in Figure 8 more numerous and closer together than in that shown in Figure 7.

The pillars usually terminate at the upper parts in consoles, which connect them to the beams, and at the lower part in reinforced concrete soles stiffened by four or more consoles.

Figure 9 shows a section in plan and Figure 10 in vertical section the form of core used for these consoles comprising bars *p* and ties *q;* the projecting parts forming the soles also being shown. In this case the main bars *r* of the soles are arranged in two directions.

Figure 11 illustrates in part sectional elevation and cross section a pipe for liquids under pressure as an example of the arrangement adopted for bodies required to resist tensile stresses. In such a case the main cores *s*, are wound in a helical manner with preferably a fine pitch whilst the secondary cores *t* are fitted inside the main cores. External helices *u* of long pitch are provided for stiffening the whole. The pipes are manufactured in convenient lengths

in some cases ten feet, and the lengths are joined by sleeves *x* or short pieces of similar piping of slightly larger internal diameter than the external diameter of the pipes to be joined, a suitable cement being inserted in the intervening space. For circular tanks or reservoirs the same construction is adopted as for pipes.

When the diameter is very large, say more than thirty feet, in addition to the main cores *s* (or rings composed of segments joined by overlapping the bent ends) and also in addition to the secondary rectilinear cores *t*, thicker vertical iron bars *v* may be spaced at intervals as shown in Figure 12. These iron bars *v* are used so as to facilitate the construction of the core properly speaking, more especially in the case of domes. In the case of a spherical dome or conical roof or arch the thrust may be equilibrated by an upper reinforced band *w* of suitable section as shown in Figure 13 which is a part sectional elevation.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is:—

1. Reinforcing concrete constructions in the manner hereinbefore described with reference to Figures 1 to 6 of the drawings.

2. Reinforcing concrete constructions in the manner hereinbefore described with reference to Figures 7 to 10 of the drawings.

3. Reinforcing concrete constructions in the

manner hereinbefore described with reference to Figures 11 to 13 of the drawings.

Dated this 10th day of November, 1904.

MARKS & CLERK,
18, Southampton Building, London, W.C.
13, Temple Street, Birmingham, and
30, Cross Street, Manchester.
Agents.

[This Drawing is a reproduction of the Original on a reduced scale.]

A.D. 1904. Nov. 10. N° 24,371.

COIGNETS' Complete Specification.

[This Drawing is a reproduction of the Original one reduced scale.]

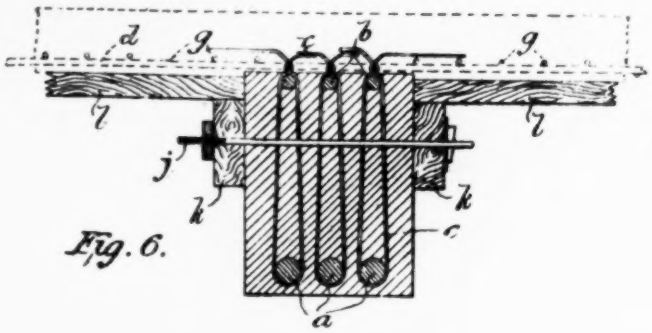


Fig. 6.

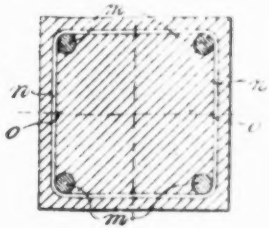
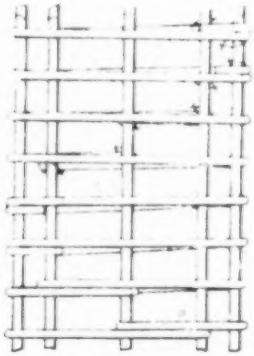


Fig. 7.



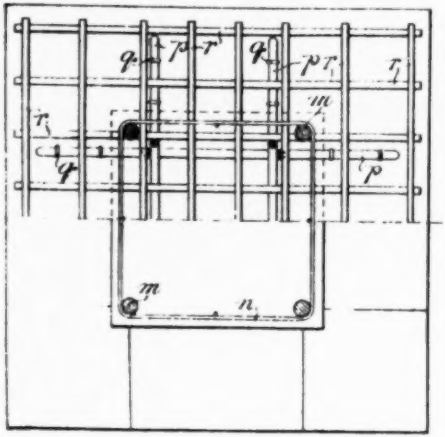
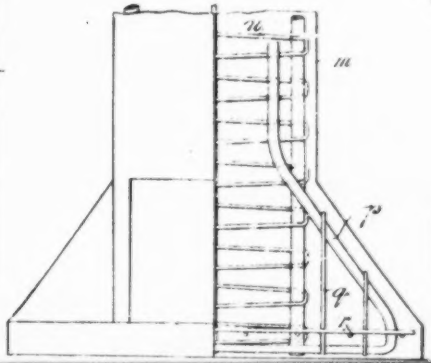


Fig. 9.



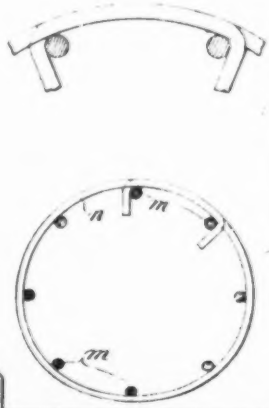


Fig. 8.

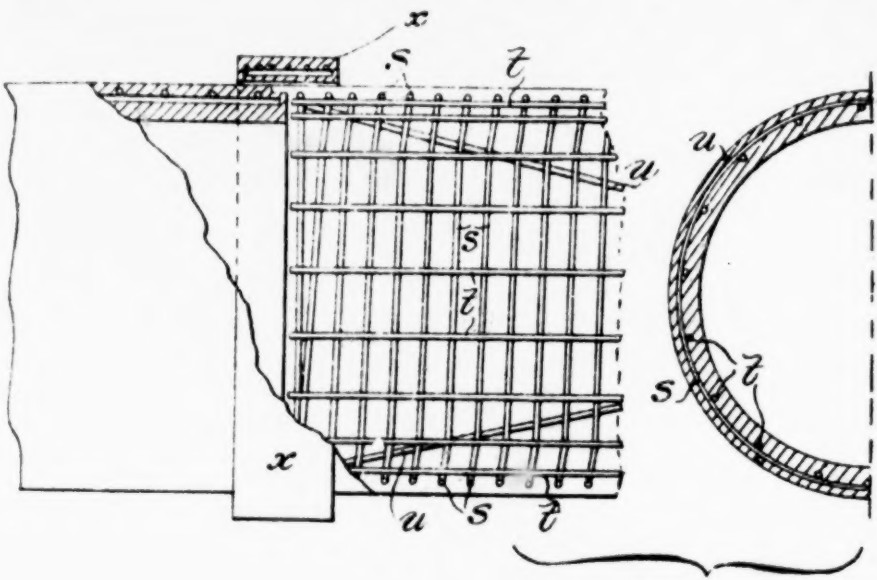


Fig. 11.

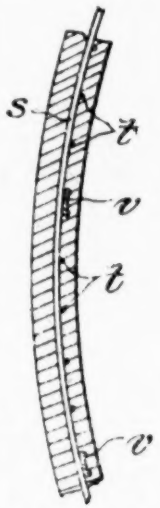


Fig. 12.

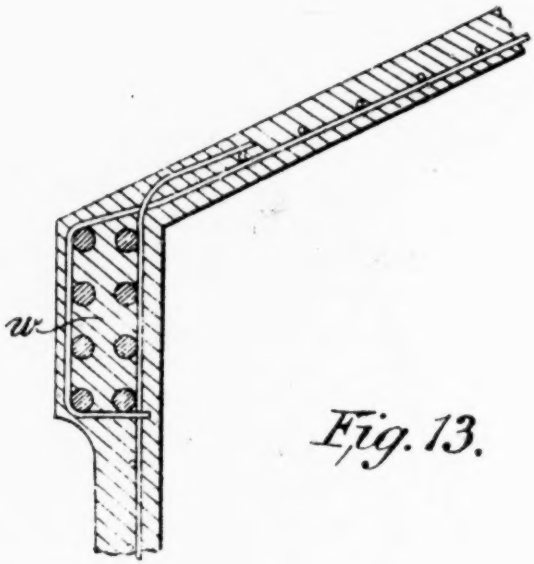
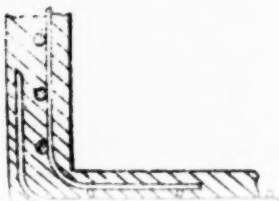


Fig. 13.



This Drawing is a reproduction of the Original on a reduced scale.

DEFENDANT'S EXHIBIT AA-6.

REPUBLIQUE FRANCAISE.

OFFICE NATIONAL D ELA PROPRIETE INDUSTRIELLE.

BREVET D'INVENTION
du 21 juin 1902.

(Library Apr 20 1903 U. S. Patent Office)

VII.—Travaux de construction.
1. Materiaux et outillage.

Brevet de quinze ans demande le 21 juin 1902 par M. PELLEGRIN (Joseph), *pour tuyaux en beton de ciment arme a manchons et a emboitements.* (Delivre de 10 novembre 1902; public le 6 mars 1903.)

L'invention est relativ a des perfection-noments apportes dans la construction de tuyaux en beton de ciment arme, donnant au point de vue industriel un produit nouveau denomme (tuyau en beton de ciment arme a manchon et a emboitement).

Lesdits tuyaux peuvent se fabriquer, de tous diametres, de toutes longueurs et de toutes formes utiles a l'industrie et au commerce toujours avec manchon et emboitement.

DETAILS DES DESSINS.

Figure no 1.—Presente un tuyau droit de trois metres de longueur non compris le manchon et l'emboitement.

Figure no 2.—Presente une coupe dudit tuyau suivant A. B.

Figure no 3.—Presente l'ossature metallique d'une seule piece avec manchon.

Figure no 4.—Presente une coupe sur C. D. de ladite ossature.

Figure no 5.—Presente deux tuyaux assembles avec leur manchon et emboitement et la coupe d'un joint fait.

Comme dans la figure no 3, on voit l'ossature metallique qui est confectionnee d'une seule piece avec son manchon qui est compose de directrices longitudinales et de spires, l'epaisseur et l'ecartement du metre et l'epaisseur du tuyau ainsi que la resistance a obtenir; l'ossature terminee est ensuite logee dans des moules faits a dessein, puis, on procede au coulage du beton de ciment, qui est compose de 300 litres de sable lave et de 700 litres de ciment portland.

REVENDICATIONS.

En resume, je revendique le perfectionnement dans les tuyaux en beton ciment arme decrit ci-dessus et presentes sur le dessin cijoint et dont les points caracteristiques et essentiels sont:

1 re figure.—Tuyaux en beton de ciment arme, avec manchons et emboitements.

2e figure.—L'ossature metallique d'une seule piece, avec son manchon a emboitement.

3e figure.—L'assemblage des tuyaux par le manchon a emboitement et joints en ciment.

Lesdits tuyaux, peuvent etre employes partout ou

il peut en etre fait usage, tant dans l'industrie que dans le commerce.

Izeaux, le 21 juin 1902.

Joseph PELLEGRIN.

Prix du fascicule: 1 franc.

FRENCH PATENT No. 323,457.

The invention relates to improvements involved in the construction of reinforced concrete tubes, producing from an industrial point of view, a new product called (jointed reinforced concrete tube).

The said tubes can be manufactured of any diameter, of any length, and of any form desired, in industry and commerce always with mating ends.

Details of the Drawings.

Figure No. 1—shows the exterior of a jointed tube two to three meters in length.

Figure No. 2—shows a section of said tube on line A-B.

Figure No. 3—shows the metallic framework of a single length with connecting sleeve.

Figure No. 4—shows a section on C-D of the said framework.

Figure No. 5—shows two tubes assembled with their mating ends assembled and the joint in section.

As shown in Figure 3, the metallic framework is seen, which is manufactured of a single piece, with its female end, which is composed of lengthwise and spiral strands. The thickness and the mesh of the metal used are always calculated according to the diameter and thickness of the tube, so that the necessary resistance is obtained. The finished framework is then placed in molds of the proper design, then the cement is cast, which is composed of 300 liters of washed sand and 700 liters of Portland cement.

Claims.

In summary I claim the improvement is reinforced concrete tubes above described and shown in the subjoined drawing and of which the characteristic and essential points are:

1st figure—Reinforced concrete tubes, having male and female connections.

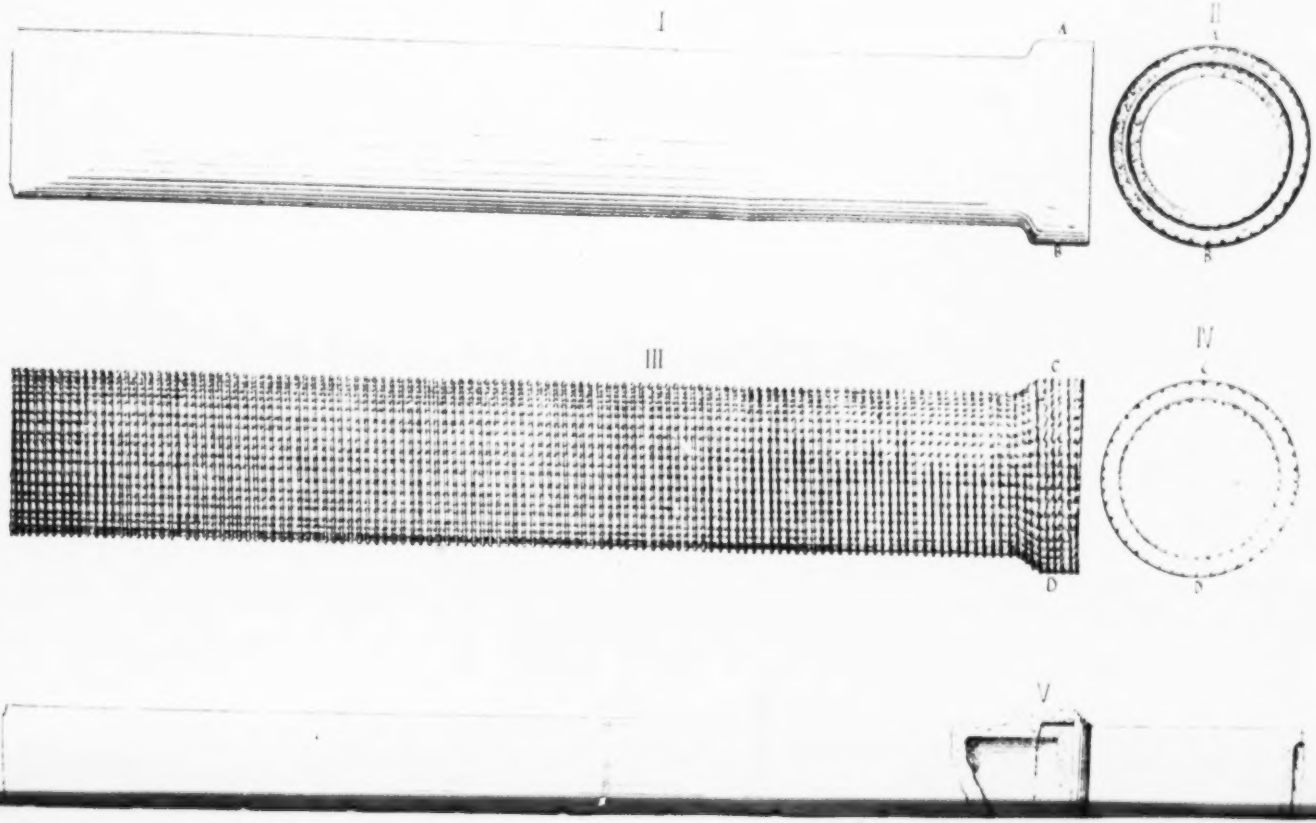
2nd figure—A metallic framework of a single piece, having male and female connections.

3rd figure—The assemblage of tubes by means of male and female connections and secured with cement.

The said tubes may be employed wherever they can be made use of, both in industry and commerce.

Signed, June 21, 1902.

JOSEPH PELLEGRIN.


I
A
B
II
A
B
III
C
D
IV
C
D
V

DEFENDANT'S EXHIBIT AA-8.

(LIBRARY FEB 20 1894 U. S. Patent Office.)

Ausgegeben Den 11, Januar 1894.

KAISERLICHES PATENTAMT.

PATENTSCHRIFT

—Nr 73004—

Klasse 80: Thon- und Steinwaaren-Industrie.

ROBERT KIESERLING in HAMBURG und MAX MOLLER in ALTONA.

Verfahren zur Herstellung von Cementhohlkorpern aus Stampfbeton mit stufenweise eingeformtem Eisengerippe.

Patentirt im Deutschen Reiche vom 24. Marz 1892 ab.

In manchen Fallen ist es zweckmafsig, zur Erhohung der Festigkeit von Cementhohlkorpern in die letzteren Eiseneinlagen einzuformen, welche von der Cementmischung vollstandig umhullt werden. Sobald aber diese Eiseneinlagen, die ous Drahtgeflecht, Drahtgewebe oder einer Reihe fest mit einander verbundener Stucke bestehen konnen, gleich als ein Ganzes aufgestellt werden, was bisher ausnahmslos geschah, werden die Vorzuge, welche das stufenweise Einformen des Cementhohlkorpers besitzt, sehr beschrankt, weil das Einstampfen der Cementmischung in die Form haufig fast unausfuhrbar ist.

Um nun das Einstampfen der Cementmischung in die Form, den einzigen Weg, Hohlkorper von grofster Festigkeit und Gleichmafsigkeit im inneren Ge-

fuge zu erzielen, beibehalten und doch gleichzeitig den derart erzeugten Hohlkorper mit einem Eisengerippe versehen zu konnen, ohne das Einstampfen zu behindern, soll das nachstehend beschriebene Verfahren dienen.

Dasselbe besteht im wesentlichen darin, dafs das Eisengerippe aus einzelnen Theilen zusammengesetzt wird, die nach und nach, entsprechend dem Fortgange der eigentlichen Formarbeit, in Verbindung mit einander gebracht werden.

Da nun im Allgemeinen aus praktischen Grunden die das Einstampfen bewirkenden Mittel in senkrechter Richtung bewegt werden, so ist nachstehend, obwohl es ja auch denkbar ist, dafs von der Seite eingestampft wird, angenommen worden, dafs das einstampfende Werkzeug in senkrechter Richtungf auf- und abwarts bewegt wird. In dem Falle ist es angangig, die senkrecht oder annahernd senkrecht stehenden Thiele des Eisengerippes sofort als Ganzes aufzustellen, oder aber auch dieselben aus einzelnen uber einander liegenden Stucken nach und nach, dem Fortgange der Formarbeit entsprechend, zusammenzusetzen.

Dieses letztere Verfahren, welches fur die Herstellung von Hohlkorpern der verschiedensten Form und Grofse anwendbar ist, soll nunmehr an einem Beispiele erlautert werden. Im engen Anschlufs an das in der Patentschrift Nr. 73003 beschriebene Verfahren der Herstellung eines Cementrohres aus Stampfbeton soll nachstehend angenommen werden, dafs es sich wieder um die Herstellung eines Cementrohres, jedoch mit Eisengerippe, handelt.

Zur Herstellung desselben verfahrt man folgendermafsen:

Nachdem in den uber der Grundplatte und zwischen dem Kern und der untersten Ringschicht des Mantels bestehenden Hohlraum eine in ihrer Starke nach der Grofse des herzustellenden Rohres sich richtende Lage a der Cementmischung rings um den Kern eingestampft ist, wird auf diese Lage ein Ring *b* gelegt, der entweder aus einem Stuck oder auch aus mehreren mit einander verbundenen oder auch unabhangig von einander bestehenden Theilen gebildet ist. Dieser Ring *b* bezw. diese einzelnen von einander unabhangigen Stucke werden mit senkrechten Stutzen *c* versehen, die mit dem einen Ende unter den Ring geschoben und umgeschlagen werden, wie das in den Fig. 2 und 3 ersichtlich ist.

Die Verbindung der Stutzen *c* mit dem Ring *b*, sowie die Form dieser Stucke ist naturlich mannigfacher Abanderungen fahig, ohne dafs darum der Zweck derselben verfehlt wurde. Nachdem nun diese Stutzen, welche wegen ihrer im Verhaltnifs zur Dicke des Rohres aufserst mafsigen Starke das Einstempfen des Betons in keiner Weise hindern, sammtlich aufgebracht sind, wird der noch freie Hohlraum zwischen dem Kern und der ersten Mantelschicht bis an den Rand der letzteren fest mit der Cementmischung ausgestampft und darauf auf dis Betonoberflache bezw, die Stutzen *c* ein Ring *b*1 aufgelegt, der entweder schon mit Stutzen *c*1 versehen ist oder jetzt erst solche durch Unterfuhren und Umschlagen der Enden derselben um den Ring erhalt. Ehe nun die zweife Mantelschicht aufgebaut und

der zwischen derselben und dem Kern bestehende Hohlraum mit der Cementmischung ausgefullt wird, werden die aus dem eingestampften Beton herausstehenden Enden der Stutzen *c* mit dem von denselben getragenen Ring *b* in passender Weise, am einfachsten durch Umschlagen um denselben, verbunden. Darauf wird die zweite Mantelschicht aufgebaut und der von dieser Schicht einerseits, dem Kern und der Betonoberflache der ersten Lage andererseits begrenzte Hohlraum durch Einstampfen der Cementmischung bis an den oberen Rand der Mantelschicht ausgefullt. Nachdem dann ein neuer Ring *b*2 aufgelegt und mit Stutzen *c*2 versehen ist, werden die Enden der Stutzen *c*1, wie das vorher bei den Stutzen *c* und dem Ring *b* geschah, um den Ring *b*2 gebogen und die dritte Mantelschicht aufgebaut.

In dieser Weise schreitet die Bildung des Rohres sowie das Einformen des Eisengerippes vor, ohne dafs durch das letztere das Einstampfen des Betons in irgend welcher Hinsicht erschwert ware. Ist das Rohr ein muffenloses, dann wird der letzte Ring, der keine senkrechten Stutzen mehr erhalt, nicht in der Hohe der oberen Kante der letzten Mantelschicht gelegt, sondern einige Centimeter tiefer und in der alten Weise mit den unter demselben liegenden Stutzen verbunden. Der uber dem letzten Ring begende freie Raum der Form wird darauf ausgestampft und so erreicht, dafs das Eisengerippe von der Cementmischung allseitig umgeben ist.

Handelt es sich dagenen um die Herstellung eines Rohres mit Muffe, dann wird in gleicher Weise verfahren, jedoch aufserdem noch in Hohe des oberen

Randes jener Mantelschicht, welche etwa in der Mitte der Muffe abschliefst, eine Seitenstrebe *d* abgezweigt, welche eine oder auch bisweilen zwei Stutzen *e* tragt, die mit Ringen *f* in Verbindung stehen. Der letzte dieser Ringe besitzt naturlich auch keine Stutzen. Derselbe wird vielmehr nur von solchen getragen und steht wieder einige Centimeter unterhalb des oberen Randes der Muffe, so dafs also auch dieses Nebengerippe allseitig von dem Beton umgeben ist.

Von dem eben geschilderten Verfahren zwar etwas abweichend, mit demselben aber in dem oben dargelegten Pripcip ubereinstimmend, sind die in der Zeichnung noch veranschaulichten Verfahren.

In den Fig. 5, 6 und 7 ist in Seitenansicht und Grundrifs ein Eisengerippe dargestellt, dessen senkrechte Stutzen *g* aus einem oder auch mehreren mit einander verbundenen Stucken bestehen konnen. Diese Stutzen sind je mit einer Reike von Aussparungen versehen, in welche ein Draht *h* liegen kommt, welcher spiralformig auf die Stutzen, dem Fortgange der Formarbeit entsprechend, gewickelt wird. Die in 7b und 7c gegebenen Ausfuhrungsformen empfehlen sich insofern, als bei Beanspruchung des Rohres auf Zug dre Draht nach beiden Richtungen hin ein Widerlager findet, was bei der durch die Fig. 5 und 7a veranschaulichten Ausfuhrungsform nicht der Fall ist. Das in den Fig. 8 bis 11 dargestellte Eisengerippe bedarf hinsichtlich seiner Herstellung keiner weiteren Erlauterung.

Das in der Patentschrift Nr. 73003 beschriebene Verfahren und das vorliegende gleichen sich insofern

aufserordentlich, als dort Theile der Form so lange fortgelassen wurden, bis dieselben unbedingt benothigt wurden; dasselbe geschieht hier mit den einzelnen Theilen des Eisengerippes. Die Vorzuge des Verfahrens liegen, abgesehen davon, dafs das nicht genug zu schatzende Stampfverfahren beibhalten werden kann, darin, dafs durch das Eisengerippe nicht allein die Festigkeit des Hohlgegenstandes wesentlich erhoht wird, sondern auch der Cement vor und wahrend des Abbindens einen vorzuglichen Halt gewinnt, so dafs das Abbrechen des Mantels sowohl als des Kernes sowie das Fortschaffen des Rohres von der Grundplatte fruher geschehen kann, als das bei Herstellung der Rohre nach dem in der erwahmen Patentschrift beschriebenen Verfahren der Fall ist.

PATENT-ANSPRUCH:

Bei dem im Patent Nr. 73003 beschriebenen Verfahren zur Herstellung von Cementhohlkorpern aus Stampfbeton ein stufenweise eingeformtes Eisengerippe, dessen Aufbau in der Weise erfolgt, dafs jene Theile desselben, welche parallel oder annahernd parallel zur Bewegungsrichtung des einstempfenden Werkzeuges liegen, ganz aufgebaut oder allmalig vervollstandigt werden, wahrend die diese Theile durchkreuzenden Stucke des Eisengerippes entsprechend dem Fortgange der Formarbeit eingefugt werden, zum Zweck ungenhinderten Einstampfens des Betons in die Form.

German Patent.

Translation of German Patent No. 73,004—Robert Kisserling of Hamburg and Max Moller of Altona.

The Processes for the Production of Hollow Concrete Bodies With Progressively Formed Steel Reinforcements Therein.

In certain cases it is necessary, in order to increase the rigidity of hollow concrete bodies, to form therein steel reinforcing members which are substantially entirely surrounded by the mixture of concrete. As soon, however, as these reinforcing members, which may consist of interwoven wire or of a series of bars tied tightly to one another, are set up as a unit, which heretofore was the procedure witout exception, the advantages which the progressive formation of the concrete hollow body possesses, are very much diminished, since the tamping of the concrete mixture into the form is made practically impossible thereby.

Hereinafter is described the process in which is carried out the tamping of the concrete mixture into the form (the only way to attain hollow concrete bodies of maximum solidity and uniformity in the inner layers thereof), and in which, at the same time, the hollow body thus produced, is provided with steel reinforcement, without preventing the tamping of the concrete.

The process consists essentially therein that the steel reinforcement is built up of single parts which

are gradually, according to the progress of the construction, brought into connection with one another.

Since, for practical reasons, the means employed in tamping the concrete are actuated in a vertical direction, it will be assumed, therefore, although it is also conceivable that the tamping may proceed horizontally, that the tamping apparatus is actuated reciprocally in a veritical direction. In such a case it is possible to set up at once in whole, the vertically or nearly vertically extending parts of the reinforcement, or it is possible also to gradually build up the latter of single parts superimposed vertically one over the other, according to the progress of the work.

This last procedure, which is applicable in the production of hollow bodies of the most varied forms and magnitude is now to be disclosed in connection with a typical example. In the brief review of the process for producing a concrete pipe, as described in the patent No. 73,003, it is to be hereinafter assumed that it is again a question of production of a concrete pipe, with, however, steel reinforcement therein.

For the production of the latter, the process is substantially as follows:—After a layer of concrete has been tamped about the core and immediately over a base plate and in a space between the core and the lowermost annular section of the mold, the thickness of which layer is in proportion to the size of the pipe to be made, there is laid upon this layer a ring *b* which consists of either one part or of several parts, either inter-connected or even, also, independent of

one another. This ring *b*, or according to circumstances these individual and independent parts are provided with vertically extending studs *c* which at the one end thereof are placed under and bent around the ring as is illustrated in Figs. 2 and 3.

The connection between the studs *c* and the ring *b*, as well as the form of these parts is entirely susceptible to various possible embodiments without departing from the purposes thereof. After these several studs have been applied, which by reason of their substantially small cross section in comparison to the thickness of the pipe itself do not prevent the tamping of the material in any manner whatsoever, the space between the core and the first section of the mold is filled with concrete up to the edge of the latter and the concrete tamped, and there is laid either upon the concrete surface or, according to circumstances upon the studs *c*, a ring *b*1, to which there are already applied studs *c*1 or there are now applied such studs thereto by bending the ends thereof about the ring. Before, now, the second section of the mold is applied and the space between that and the core is filled with the concrete mixture, the studs *c* protruding through the tamped concrete are connected with the ring *b*1 in a convenient manner, preferably by bending, which ring is carried by the studs *c*. Thereupon the second mold section is applied and the space between the latter, the core, and the concrete surface and the layer, is filled with concrete up to the upper edge of the mold section and tamped. After a new ring *b*2, has been applied provided with studs *c*2, the ends of the studs *c*1, as was the case

with the studs *c* and the ring *b*, I now bend about the ring b^2 and the third mold section thereby built up.

In this manner the formation of the pipe as well as the construction of the steel reinforcement proceeds, without, however, that the latter interferes with or makes difficult the tamping of the concrete in any manner whatsoever. If the pipe is to be without a coupling flange, then the last ring, to which there are attached no upright studs, is not laid at a level corresponding with that of the edge of the last mold section, but is placed several centimeters lower and is connected with the studs extending immediately thereunder in the manner heretofore described. The space immediately over the last ring is now filled and tamped with concrete so that the reinforcement is entirely surrounded on all sides by the concrete mixture.

If it is a question of constructing a pipe with a coupling flange, then the process is carried out in the same manner, but there is branched off a side strut *d* at the height of the upper edge of that mold section which terminates about at the center of the coupling, which side strut has mounted thereon one or two studs *e* which are connected with the rings *f*, the last of these rings has naturally no studs mounted thereupon. The latter is moreover carried by such studs and is several centimeters below the upper surface of the coupling flange, so that therefore this laterally extending reinforcement is complete surrounded by the mixture.

Departing from the above described process, but

combining therein the above described principle, there are described in the drawings various further embodiments of this invention.

In Figs. 5, 6 and 7 there is illustrated, in side elevation and in cross section, such a steel reinforcement, whose upright studs *g* may consist of one or more interconnected parts. These studs are provided with a series of notches, which are adapted to receive a wire *h*, which is wound upon the studs spirally as the construction progresses.

In Figs. 7b and 7c, are shown advantageous embodiments, in which the wire *h* is connected with the studs so as to be capable of resistance in both directions, which is not the case in the embodiments illustrated in Figs. 5 and 7a. The reinforcing structure shown in Figs. 8 to 11 requires, in view thereof, no further disclosure.

The processes described in the patent No. 73,003 and the processes herein disclosed, are extraordinarily similar insofar as in the former, the sections of the mold are left off until they were absolutely necessary; the same is the case here with the single parts of the steel structure. The advantages of the processes aside from the fact that the tamping, which cannot be given too much emphasis, can be retained, lie not only in the fact that the rigidity of the whole structure essentially is increased by reason of the reinforcement, but also in the fact that the cement both before and during the setting thereof, attains an advantageous density, so that the dissembling of the mold and the core as well as the removal of the pipe from the base plate itself, can take place much

sooner than in the construction of pipes according to the processes desribed in the above mentioned patent.

Claim:

The processes for the production of hollow concrete bodies, as described in patent No. 73,003, of "material adapted to be tamped" a steel reinforcement formed therein progressively, whose construction takes place in such a manner that such parts thereof, which lie parallel or nearly parallel to the direction of actuation of a tamping apparatus, are either built up or eventually completed, while the parts of the reinforcement extending through said first parts are inserted as the construction proceeds, for the purpose of allowing the free tamping of the material into the mold.

ROBERT KIESERLING IN HAMBURG UND MAX MÖLLER IN ALTONA

Verfahren zur Herstellung von Cementhohlkörpern aus Stampfbeton mit stufenweise eingeformtem Eisengerippe.

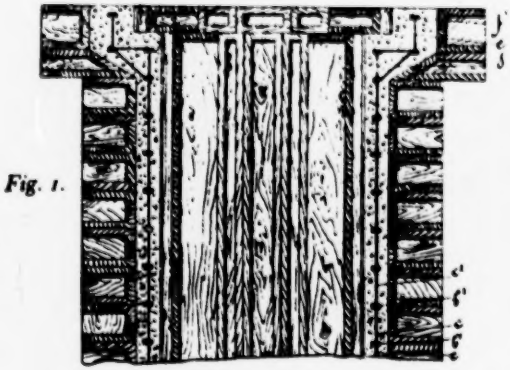


Fig. 1.

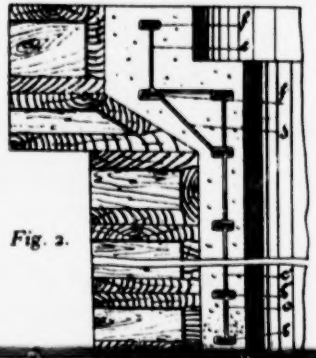


Fig. 2.

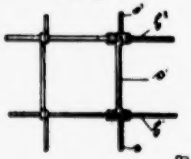


Fig. 3.

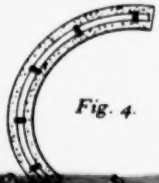


Fig. 4.

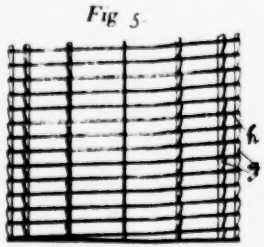


Fig. 5.

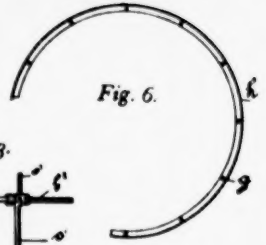


Fig. 6.

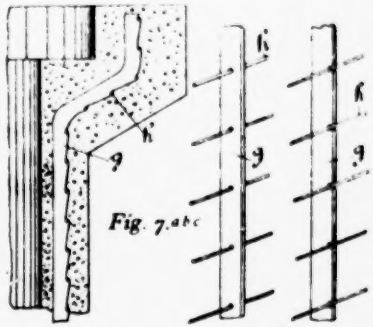
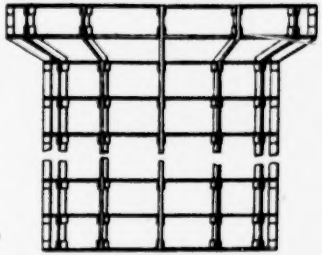


Fig. 7. a b c

Fig. 8.



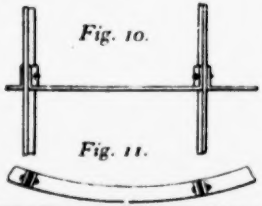


Fig. 10.

Fig. 11.

Fig. 9.

DEFENDANT'S EXHIBIT AA-11.
2—112

DEPARTMENT OF THE INTERIOR.
UNITED STATES PATENT OFFICE.

Manuscript and Photolithograph Division.
Apr 17 1917

CONFEDERATION SUISSE
BUREAU FEDERAL DE LA PROPRIETE
INTELLECTUELLE

EXPOSE D'INVENTION

(Library Nov 21 1904 U. S. Patent Office)
20 novembre 1903, 7 h. p.

Brevet No 29781 Classe 5

S. de MOLLINS, a Lausanne (Suisse).

Piece de construction en beton frette et arme.

On a donne le nom de pieces en *beton frette* a des pieces de construction en beton, dans losquelles sont noyees des helices metalliques enveloppant une portion cylindrique de la masse du beton, et on appelle pieces en *beton arme* des pieces munies de barres longitudinales placees dans les parties de la piece qui sont soumises a des efforts de tension. Il est d'uatre part a remarquer que les pieces en beton frette sont fort difficiles et couteuses a etablir a cause des grandes difficultes pratiques qu'il y a

L'objet de la presente invention est une piece de noyer dans le beton une helice metallique continue.

construction en beton, dans laquelle le frettage est obtenu non plus par une helice continue mais par des cercles paralleles qui sont d'un maniement facile et economique au chantier. Cette piece est en outre munie de barres longitudinales destinees a resister aux efforts de tension, c'est-a-dire d'augmenter la resistance de la piece au flambage.

Le dessin ci-joint, donne a titre d'exemple, montre deux formes d'execution de l'invention.

La fig. 1 est une vue en perspective d'une piece de construction dont le beton est enleve sur une partie de la longueur pour laisser voir l'armature a frettes circulaires;

La fig. 2 est une coupe transversale de l'armature montree en fig. 1;

La fig. 3 montre en coupe transversale une autre forme d'armature a frettes circulaires;

Les fig. 4, 5 et 6 montrent a plus grande echelle une piece d'attache reliant un cercle et une barre.

a sont des cercles qui peuvent par exemple etre formes par des fils metalliques de longueur convenable ayant leurs extremites soudees ou attachees, et qui sont disposes parallelement les uns par rapport aux autres et fixes par des attaches *b* aux barres longitudinales *c*.

Les fig. 1 et 2 montrent que ces dernieres peuvent etre plus rapproachees les unes des autres par place, suivant les efforts de tension que l'on doit prevoir dans l'ouvrage.

Comme on le voit fig. 4, 5 et 6 chaque piece d'attache *b* forme un etrier entourant une barre *c* du cote oppose a celui ou un cercle *a* sappuie contre cette

derniere et dont les bouts sont replies par dessus ledit cercle *a* de chaque cote de ladite barre *c*.

Les pieces d'attache *b* (ou etriolets) relient solidement la zone de tension de la piece de construction a sa zone de compression, ce qui permet a la piece de construction en beton frette et arme de resister avec succes aux efforts de flexion aussi bien qu'a ceux de compression.

Resume.

1 Piece de construction en beton frette et arme, caractrisee par des cercles disposes parallelement les uns aux autres et enveloppant une portion cylindrique de la masse de beton et par des barres longitudinales destinees a resister aux efforts de traction;

2 Piece de construction telle que revendiquee sous chiffro 1, dont let cercles sont relies avec les barres longitudinales par des pieces d'attache metalliques;

3 Dans une piece de construction telle que revendiquee sous chiffre 1 et 2, des pieces d'attache telles que representees aux fig. 4 a 6 du dessin.

S. de MOLLINS,
Maudataire: E. IMER-SCHNEIDER, a Geneve.

SWISS CONFEDERATION.

Federal Bureau of Intellectual Property.

STATEMENT OF INVENTION.

Patent N. 29781. Nov. 20, 1903, 7 p. m. Class 5.

S. de Mollins, Lansanne (Switzerland).

Building Element of Hooped Concrete.

Hooped concrete is the name given to those building members of concrete in which the metal helices which enveloped cylindrical portions of the mass of concrete are embedded, and the name of armored concrete to those members provided with bars placed longitudinally in those parts subjected to tension stresses. On the other hand, it is to be noticed that the members of concrete are very difficult and expensive to produce because of the great practical difficulty that there is to embed a continuous metallic helix in the concrete.

The object of the present invention is a concrete building member in which the hooping is obtained not only by a continuous helix but by parallel rings which are easy to handle and economic to store. This member is also supplied with longitudinal bars intended to resist tension stresses, that is to say, to increase the resistance of the member to buckling.

The accompanying drawing, given as an example, shows two methods of embodying the invention.

Fig. 1 is a perspective view of a building member

in which the concrete is broken away for part of the length for the purpose of permitting the circular hooped reinforcements to be seen.

Fig. 2 is a transverse section of the reinforcement shown in Fig. 1.

Fig. 3 shows a transverse section of another form of reinforcement of circular hoops.

Figs. 4, 5 and 6 shows an attaching device to connect a ring and a bar, on a larger scale.

a are the rings which may have been formed, for example, by metal wires of convenient length having their ends soldered or connected, and which are disposed parallel to each other and connected by the attachments *b* to the longitudinal bars *c*.

Figs. 1 and 2 show that these last may be closer together, following the tension stresses, which should be provided for in the work.

As seen in Figs 4, 5 and 6 each connector *b* forms a stirrup clasping a bar *c* at the side opposite to that where a ring *a* is supported against it, the ends of the connectors being bent around said rings *a* on each side of said bar *c*.

The attachments *b* (or little stirrups) solidly unite the zone of tension of the building element to the zone of compression which permits the building element of armored and hooped concrete to successfully resist the flexing stresses as well as those of compression.

Resume.

1. A building element of armored and hooped concrete characterized by rings disposed parallel to each

other and enveloping a cylindrical portion of the mass of concrete and by longitudinal bars which are intended to resist tensioned stresses.

2. A building element such as claimed in number 1, in which the rings are attached to the bars by means of metal connectors.

3. In a building element such as claimed in numbers 1 and 2, connectors such as are represented in Figs. 4 to 6 of the drawing.

S. de MOLLINS.

Attorney, E. IMER SCHNEIDER, at Geneva.

403

Brevet N° 29781.
1 feuille.

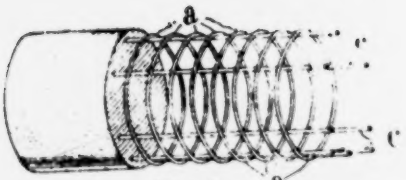


Fig.1

Fig.2.

Fig.3.

Fig.4.

Fig.6.

Fig.5.

DEFENDANT'S EXHIBIT II.
2—112

DEPARTMENT OF THE INTERIOR.
UNITED STATES PATENT OFFICE.

Manuscript and Photolithograph Division.
Apr 17 1917

SCHWEIZERISCHE EIDGENOSSENSCHAFT
EIDGEN. AMT FUR GEISTIGES EIGENTUM
PATENTSCHRIFT

(Library U. OCT 8 1906 S. Patent Office)

Patent Nr. 19271 Klasse 5
2. Februar 1900 4¼ Uhr p.

Max MUNCH, in Bern (Schweiz).

Neuartiger Fachwerktrager als Einlage fur tragende Bauteile aus Beton, Ziegelmauerwerk etc.

Gegenstand vorliegender Erfindung ist ein Fachwerktrager, welcher als Einlage fur tragende, aus Beton, Ziegelmauerwerk etc. gebildete Bautiele, z. B. Balken, Decken, Wande etc., dient. Auf beiliegender Zeichnung ist der Erfindungsgegenstand in mehreren beispielsweisen Ausfuhrungsformen durch die Fig. 1-5[a] dargestell.

Derselbe ist bei den durch die Fig. 1-1[a] und 2-2[a] dargestellten Ausfuhrungsformen gebildet aus einer untern Gurtung *a* und einer obern Gurtung *b*, um welche beiden Gurtungen ein aus Metall bestehendes Konstruktions-material (z. B. Rundeisen, Bandeisen,

Drahtseil etc.) in solchem Verlauf geschlungen ist, daf die zwischen den beiden Gurtungen *a* und *b* befindlichen Teile dieses Konstruktions-materials Fullungsglieder *c* bieten, welche bei eingamauertem Trager Spannungen aufzunehmen und zu ubertragen im Stande sind.

Bei den durch die Fig. 3-3ª and 4-4ª veranschaulichten Ausfubrungsformen des Fachwerktragers, bei welchem die Enden der beiden Gurtungen *a* und *b* miteinander verbunden sind, sind zur besseren Ausbildung der Knotenpunkte noch quer zur Fachwerksebene liegende Knotenpunkverstarkungsglieder *d*, vorzugsweise aus Gufeisen oder Walzeisen (z. B. auch in Rohrenform), angeordnet.

Das zur Bildung der Fullungsglieder r dienende Konstruktionsmaterial kann auch, wie z. B. in Fig. 5 und 5ª dargestellt, mehrfach um die beiden Gurtungen *a* und *b* ge schlungen sein; auch konnen Fullungsglieder mit Verstarkungen *e* versehen sein (Fig. 5). Statt in einem Strang kann das zur Bildung der Fullungsglieder *c* dienende Konstruktionsmaterial auch in mehreren Strangen um die beiden Gurtungen geschlungen sein.

Zur Bildung der Gurtungen, welche gerade, gebogen etc. sein konnen, kann man Rundeisen, Flacheisen, Faconeisen, Drahtseile, Ketten etc. verwenden.

Patent-Ansperuche:

1. Fachwerktrager als Einlage fur tragende Bauteile aus Beton, Ziegelmauerwerk etc., gekennzeichnet durch eine untere und eine obere metallene Gurtung, um welche ein zur Bildung von Fullungsglie-

dern geeignetes metallenes Konstruktionsmaterial in einem Strang oder in mehreren Strangen in solchem Verlauf ein- oder mehrfach geschlungen ist, daf die zwischen den Gurtungen befindlichen Teile dieses Konstruktionsmaterials Fullungsglieder bieten, welche bei eingemauerten Trager Spannungen aufzunehmen und zu ubertragen im Stande sind;

2. Fachwerktrager nach Anspruch 1, bei welchem zur besseren Ausbildung der Knotenpunkte quer zur Fachwerkebene angeordnete Knotenpunktverstarkungsglieder angebracht sind;

3. Fachwerktrager nach Anspruch 1, bei welchem Fullungsglieder mit Verstarkungen versehen sind.

Max MUNCH.

Vertreter: C. HANSLIN & Co., in Bern.

PATENT No. 19,271.

MAX MUNCH, Bern, Switzerland.

A NEW IDEA FOR BEAMS.

A reinforcing for load supporting beams of concrete, brick work, etc.

The above mentioned invention being for beam support, having as a filler in concrete or brick work, walks, etc.

The design is illustrated in figures 1-5a, figures 1 and 1a, 2 and 2a illustrate this principle in the form of an upper and lower girder; having metal (round iron, band iron, wire, etc.) wrapped in such a manner as to act as a filling support or reinforcing so that the girder may be taken up and moved. Figures 3 and 3a, 4 and 4a, illustrate this principle in a more elaborate form:—with the ends (of the girders) connected. Figures d . . . d are cross rods or tubes, around which the wrapping material is slung as in 3a and 4a offering additional strength at these points. This wrapping material may be multiplied indefinitely, or more strands may be used.

In the construction of girders which may be straight, bent, curved or otherwise—round iron, band iron, iron of special design, wire, chain, etc., may be used.

Claims.

1. A type of beam, construction for use in concrete, brick work, etc., specified as an upper and lower metal girder, having one or a number of strands

of material, as hereinbefore stated, wrapped in such a manner that when filled with the binding materials the beam may be moved and put into place.

2. Beams as per 1, having in addition cross members to give additional strength at the tie points.

3. Beams as per 1 wherein the wrapping material has been reinforced.

P. T. O.

Max Munch.
2. Februar 1900.

Patent Nr. 19271.
1 Blatt.

EXPERIMENTAL RESEARCHES

ON

REINFORCED CONCRETE

BY

ARMAND CONSIDERE
Ingenieur en Chef des Ponts et Chausees,
TRANSLATED AND ARRANGED

BY

LEON S. MOISSEIFF, C. E.
Assoc. Mem. Am. Soc. C. E.

WITH AN INTRODUCTION

BY

THE TRANSLATOR

AUTHORIZED EDITION

NEW YORK
McGRAW PUBLISHING COMPANY
114 LIBERTY STREET
1903

15. Types of Hooped Concrete.

The good results of hooped concrete depend on the proper arrangement of the hooping. It is evident at the start, that the hoops must be well locked and that they must not open under the internal pressure of the concrete. If the inclosing reinforcement is made of other material than metal, the stresses which it produces in the concrete must not injure its resistance to compression endwise, which is its main stress. The experiments reported earlier in this chapter have also proved that the hoops must be near to each other to give to the concrete a satisfactory coefficient of elasticity and column resistance. To duly appreciate the degree of regularity required for the spacing of the hoops a distinction should be made between the crushing resistance and the elasticity on which the column resistance depends. It has been shown that hooped prisms always have a considerable excess of crushing resistance. It will, therefore, not impair the crushing resistance if the spacing of the hoops is not very regular. Of course, too much irregularity should be avoided and the omitting of a hoop, for instance, would prove dangerous. For the elasticity and column resistance the regularity of the spacing must not necessarily be perfect. The deformations measured over sufficient lengths depend on the average spacing for the modification of the column resistance.

Hoops of two completely different types may be used. One type consists of independent hoops, the other of continuous helicoidal spirals made of

wire or rods as long as possible. If independent hoops are employed each one must be locked so strongly as not only not to open under the internal pressure of the compressed concrete, but also not to show any appreciable deformation in its connections. Practically it is impossible to connect the countless hoops which an important structure would contain. This has never even been attempted and it is generally limited to giving the ends of each rod an excess of length which overlaps and locks by the adhesion of the metal to the concrete. The ends can be tied together if the wire is of small gauge, but this is not good practice in all cases and is almost impossible with thicker rods. The introduction of the adhesion to the concrete causes a stress which can in nowise be neglected and which is produced near the circumference of the compression members where the pressure and the tendency to flexure require all the resistance that can be afforded. In addition it must be remembered that the regularity of spacing of the independent hoops is dependent on the care and attention of the workmen, on which it is impossible to count.

These inconveniences are avoided by the use of long wires or rods bent into helicoidal spirals. Drawn wires of great resistance can be obtained up to ½-inch diameter and steel bars ⅝-inch thick can be obtained in coils 160 feet long. The thickest bars that may be required for hooping can be bought in coils at least 80 to 100 feet long. With such lengths 10 to 40 spirals can be made continuous. To insure the transmission of the tension from one bar to another

it is sufficient to embed between the last spirals of one bar the first spiral of the next and to curve in toward the center of the section the ends of the bars bent into crooks. The additional stress thus caused in the concrete acts in the central portion of the concrete where, being supported by the pressures acting in every direction and having a considerable excess of resistance, there is no danger. Experience has plainly proved the efficiency of this procedure. It could not be well used for independent hoops where the too numerous ends would crowd the section. When spirals have to be made for given prisms, an endeavor should be made to find the diameter and pitch which the metal, when left to itself, will retain, owing to its elasticity. Experience has shown that this is not difficult. The spirals once made and checked, no important errors can occur while putting them in place and concreting.

It would seem that, since the elastic efficiency of the hooping increases with the closeness of the hoops, at least within certain limits, the ideal will be reached by the use of continuous tubes; but such is not the case for several reasons. The external layer of concrete which is necessary for the protection of the tube will crack off as do all covers applied to surface subject to high stresses. The tube would generally be riveted and pierced by numerous holes which would reduce its resistance not only by reducing the section, but frequently also by punching defects. In addition to these practical objections a fundamental objection must be taken into account. It has been seen that the metal of the hoops can re-

sist the considerable deformations of the hooped prisms because its elongation is only a small fraction of the longitudinal shortening. It is far below its elastic limit while the reinforcing parallel to the axis already exceeds it. The longitudinal shells would be in the same condition as the longitudinal reinforcing rods. They would be stressed the same as these and would spread laterally the same as the concrete itself and would thus not be able to prevent its swelling. Concluding, it may be stated that independent rings show serious difficulties which increase with their closeness and the sizes of the iron used for them. Continuous shells, on the other hand, have little efficiency and are exposed to atmospheric action. The best type of hooping thus appears to be helicoidal spirals of suitable dimensions.

For the reported experiments a single volution was used which was cut by a plane perpendicular to the longitudinal axis in a single point. Two modifications of the same may be used. One consists in having two or three wires, instead of one, wound in a spiral doubling or tripling at the same time the pitch of the screw so as to maintain the same spacing of spirals. This can be done if it is not desired to rely on a single wire, though it has not been worked otherwise than by bending it in the spiral shape. The other modification consists in giving to the spirals different diameters, instead of the same for all, and having the direction of the spirals in the opposite direction. This would prevent any torsional tendency in the concrete, but torsion is

evidently out of question in the structures discussed. From the above the author concludes:

To give to concrete a high ductility and to increase at the same time to a high degree its elastic limit and crushing as well as column resistance, the hooping must form close loops and have the least number of joints. These conditions lead to the use of helicoidal spirals combined with longitudinal rods forming a continuous skelton which resists efficiently the transverse swelling of the concrete.

16. The Method of Manufacture of Compression Members.

Hooped concrete, the same as concrete-steel generally, will take many forms and have many applisations which will determine the methods of its construction. Nothing general can be said on this subject, and the following remarks apply only to columns or compression members of sections approaching to circles and intended to resist pressures endwise.

The importance in such members of elastic symmetry, that is, of the equality for the values of the coefficient of elasticity and the elastic limit at different points of the same section is easily understood. The lack of symmetry causes curving and invites flexure. But it is practically impossible to obtain elastic symmetry in members concreted while lying longitudinally, as it is seen at once that there must exist differences between the upper and lower layers as to tamping and distribution of water, cement, sand, and stone. By examining and

sounding with a hammer different parts of a member appreciable differences can almost always be noticed in the compactness. This consideration tends to the adoption of vertical moulding for members compressed endwise; but it should be noted that this does not apply to beams whose horizontal layers are subjected to different stresses. For them the sum of their moments only is of importance and not the distribution over the section.

Vertical moulding has also other advantages. It tends to place the stones with their flat sides perpendicular to the direction of the pressure, the same as in well built masonry. Horizontal moulding, on the contrary, places them in the most unfavorable position. The concrete being better confined in vertical moulds than in horizontal, tamps more quickly and much better. In members reinforced by hoops and longitudinals pressing against the inner surface of the hoops the whole central portion is free for vertical ramming, and the tamping tool can strike the concrete without shaking the reinforcing and disturbing the previously tamped portions. If members which are to be built in a different position are moulded vertically they get the advantage of being made in improved moulds provided with stops for the spacing of the spirals and in a covered shop protected from the rain, which is dangerous during moulding, and the sun which is not less dangerous during the early time of setting. Thorough inspection in a shop is easy and only a small number of selected workmen are required. For complete safety all members should be carefully examined and their

quality judged by sounding with a hammer, which gives valuable information to the experienced man, and by weighing from which the density of the member could be computed and which would add additional information on the character of the concrete. Indeed, for a concrete of a given proportion the elastic limit and the resistance vary in the same sense as the density and are in proportion to the intensity of the sound. Members not up to the standard could then be rejected.

Vertical concrete members can be taken out of the moulds at the end of six days. The same moulds can then be used over again many times. Beginning sufficiently early with the making of the members, they will

DEFENDANT'S EXHIBIT V.

IN THE

DISTRICT COURT OF THE UNITED STATES

FOR THE WESTERN DISTRICT OF PENNSYLVANIA.

GEORGE E. VANDENBURGH, vs. ELECTRIC WELDING COMPANY.	No. 127. May Term, 1917. In Equity.

STIPULATION.

It is stipulated and agreed that the attached translation of Sections 338, 339 and 340 of the book entitled Le Beton Arme by Paul Christophe, translation made by Horace R. Thayer, may be taken for the purposes of this case as a correct translation of the aforesaid portions of the said book and that the said attached translation may be substituted for defendant's exhibit 00.

EDWARD A. LAWRENCE,
Solicitor for Plaintiff.

FRED'K W. WINTER,
Solicitor for Defendant.

TRANSLATION FROM LE BETON ARME.

By PAUL CHRISTOPHE, pp. 337-341—Paris, 1902.

Translation of Defendant's Exhibit V.

#338. Mr. Bordenave of Paris, a maker of reinforced concrete pipes, and one of the first to employ the new process (See Chap. 1, No. 5) has devised a special system which he has named "Sidero-cement" (See No. 56). It is particularly designed for water pipes. In important instances it has been applied to diameters of 10 to 32 inches and to heads not exceeding 82 feet.

The reinforcement of the "Sidero-cement" pipes (Figs. 634-635 and Figs. 638-639) is formed of small special double Tee sections, curved in spirals, and wired together at intersections with inside straight bars of similar cross section.

Ten sections are employed for these special steel bars varying from 5/16" x 1/8" x 1/16" (approx.) to 1" x 7/16" x 3/32", with a weight per foot running from .084 H. R. T. to .58 pounds.

The pipes are cylindrical. The joints are made by means of a ring constructed in the same manner as the pipes (Figs. 636-637 and Figs. 638-639). The space of 3/8" to 1" between the heads of the two pipes, and that between pipes and ring is filled with cement mortar. The Bordenave system is applicable to egg shaped sewers and ordinary canals of every form as well as to circular conduits.

#339. CONDUITS AT BONE. In 1893, and 1895-6, M. Bordenave built several sections of re-

inforced pipe at Bone, Algiers, with a total length of 22 miles. They were used to furnish the city with drinking water. This diameter was 23½ inches and they withstood pressure varying from 26.4 to 84 feet.

The reinforcing steel is 1/2" x 3/16" x 1/16" weighing .15 lbs. per ft. For a pressure of 47 feet, the thickness of the pipe is 1-9/16"; the guide spirals are spaced 3-1/4" apart. For a head of 78 feet, the thickness is increased to 1-3/4"; and the spiral spacing is reduced to 1-15/16". In both cases the spacing of the longitudinal is 3-1/4 inches.

#*340.* THE BONNA SYSTEM. Mr. Bonna, a Parisian engineer, is the inventor of a system of construction of reinforced concrete pipes closely resembling the "Sidero-cement." Like the latter, the Bonna System is designed for the construction of water pipes under pressure. In this kind of work he has solved some very difficult problems. The diameter of the Bonna pipe has reached 71 inches; the head has been as high as 328 feet.

The reinforcement is formed of steel with a cruciform cross section. The principal bars, situated on the outside, are independent circular hoops or spirals. These bars are wired together or the wiring may be omitted; the longitudinals then carry upon their exterior faces, notches regularly spaced to receive the bases of the hoops. On the other side they are held in place by supplementary rings placed inside and about 39 inches apart.

As has been said above (No. 335), the pipes of reinforced concrete should be covered with a water

proof coat when the pressure exceeds a certain limit. In the Bonna system, this cover is made of lead covered sheet iron, or thin plain iron plates, the strength of which is not taken into account in calculating the frame or skeleton of the pipe. This waterproofing can simply form an interior lining (No. 341), but in order to protect it from the water, it may be imbedded in the cement. In that case it is surrounded by two sets of reinforcement, one inside, the other outside (No. 342). The latter only is considered in calculating the strains.

In certain cases the cement itself should be protected against the action of water. For some conduits carrying filthy or acid industrial water, Mr. Bonna puts in the interior of the pipes a glass tube in short sections connected with putty. In order to allow this tube to withstand a given pressure without breaking, it is cut with a diamond lengthwise. Instead of glass, enamelled sheet iron, ebonite or tar paper may be used. In certain cases it is sufficient to paint the interior of the pipes with a composition varied according to the results sought.

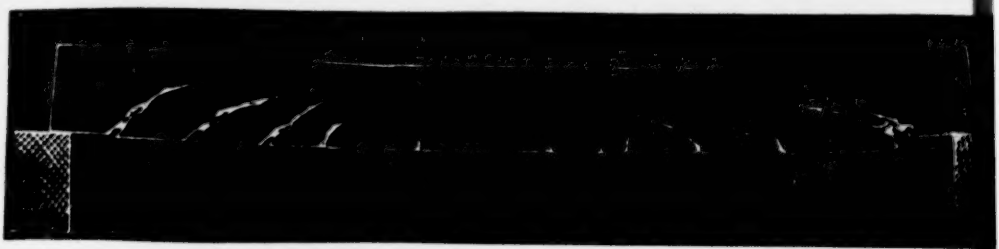
As in the Bordenave system, the Bonna pipes are constructed of cylindrical sections which are assembled by the aid of rings constructed like the pipes themselves.

A correct translation made by me.

HORACE R. THAYER.

FILED
JUL 9 1920

Also, when a reinforced concrete bar is subjected to a load, the tendency of the concrete, with its weak tensile strength to fracture is on certain lines of obliquity as indicated in the following cut of such a bar breaking under pressure.



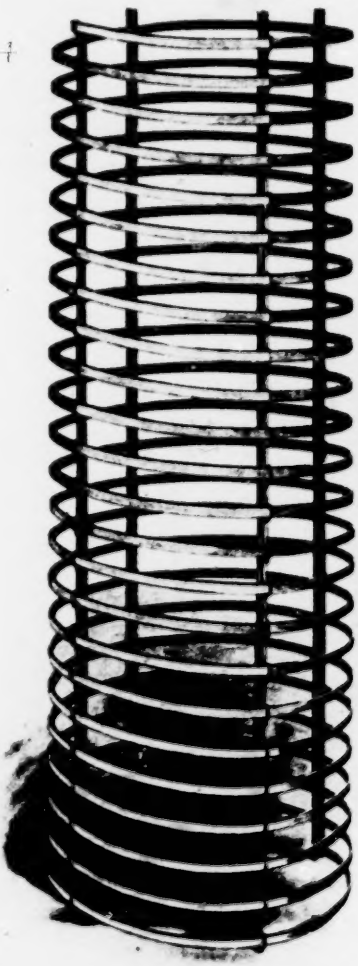
If there be attached to the main reinforcing bar, minor or subsidiary bars, extending into the concrete themselves obliquely but in a line substantially across the line of obliquity in fracture, such minor bars resist this tendency to fracture and strengthen the bar in that respect as well as protect the main bar against shearing or slipping lengthwise in the concrete. This action of minor or subsidiary bars obliquely connected with the main bar is designated as a "truss" action, because of its parallel in its supporting action to the common truss of engineering as illustrated in the ordinary truss bridge construction.

A steel bar or rod used in concrete reinforcing, whether a single rod, or a rod having minor or subsidiary rods attached thereto is well known and immediately recognized in reinforced concrete engineering by the term "reinforcing bar." This meaning of the term "reinforcing bar" should be kept in mind because of its use

No. 500
Defendant's Exhibit
No. 5
424
FILED
JUN 9 1920

KAHN SYSTEM OF REINFORCED CONCRETE

To simplify the assembling of hooped column reinforcement this Company has devised and carries in stock a spacing bar, as shown in the accompanying cut. This spacing bar is provided with a projecting rib, which is sheared from the main section to form projecting fins. The spacing of these fins corresponds to the standard pitch of the hooping bands and when bent around the bands, spaces and holds the hooping in exact position.



Hooping material is carried in stock in two sizes, namely ¼" by ½" bands and No. 0 wire. This material is rolled at the shops to various diameters and the proper number of coils in a continuous piece can be supplied when the pitch and story height are known.

In assembling the reinforcement for a hooped column, four or more spacing bars are placed on a circular form, with the fin side outward. The hooping is then slipped on and each band is placed so that the fins can be bent around it and hold it rigidly in position. The longitudinal reinforcing bars are then placed inside the core and wired to the shell at three or more points. The entire reinforcement for the column is then placed as a unit in the work.

DEFENDANT'S EXHIBIT X

425

Design for a Reinforced Concrete Column Without Patented Features.

Sir: There is a tendency to regard the field of reinforced concrete as quite monopolized by the firms using certain "systems" or patented bars, when equally as good results may be obtained by the use of simple structural shapes. The enclosed sketch for a concrete-steel column designed by the writer gives point to the foregoing.

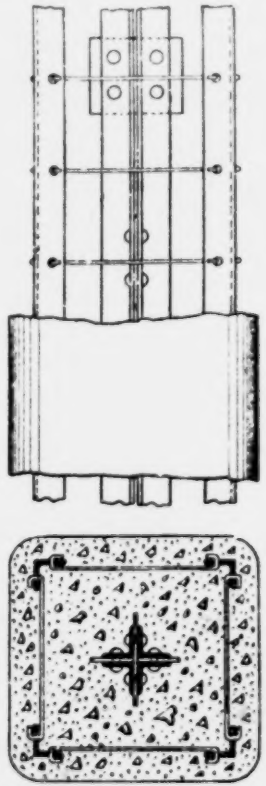
The angles at the corners effectually prevent lateral flexture, and should be properly proportioned to resist the moment due to eccentric loading. An effective bond is secured by the introduction of the wire ties, which serve also to bind the column together and to resist the shear. The angles at the center may be omitted if the load be not too heavy to exceed the crushing strength of the concrete, or may be made as heavy as desired, since the concrete supports it in such a manner as to secure the full crushing force of the steel. The batten plates, together with the rivet heads, form an excellent bond.

A column 16 ins. square, of 1:2:4 stone concrete, corner angles 2 × 2 × ⅝ ins., and center angles 3 × 3 × ½ ins. will carry a load of 117 tons up to a length of 16 ft. The cost of this perfectly fireproofed column will be about $2 per foot. The cost of a steel column of the same capacity will be about $2.28 per foot, without fireproofing.

To the knowledge of the writer no feature of this column is covered by a patent. If so, he would like to hear of it.

Chas. H. Marques.

44 Church St., Charleston, S. C., Aug. 4, 1904.



Reinforced Concrete Column Without Patented Features.

DEFENDANT'S EXHIBIT L L

A NEW FORM OF REINFORCEMENT FOR CONCRETE.

The accompanying illustrations show a new reinforcing bar for concrete construction. As will be seen the novelty consists of a provision for connecting subsidiary reinforcing or web members to the main tension bars at any point without reducing the sectional area or tensile strength of either the main or the connecting bars. The means for accomplishing this desirable result is simply to roll the bars with grooves, as shown by Fig. 1, and then press the lips of this groove together to clasp the web member. The idea is clearly shown in the various accompanying cuts, and it is stated by the inventor that the connection is so strong that in all tests so far made an attempt to pull the small bars free has always resulted in the breaking of this bar remote from the main bar.

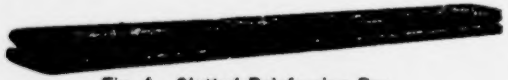


Fig. 1. Slotted Reinforcing Bar.

The drawings Figs. 2, 3 and 4 show the application of the reinforcing bar described to girders, columns and partitions. These illustrations are sufficient to show that the number of combinations is almost limitless. Fig. 2 shows a bar with stirrups attached as would be done in girder reinforcement. It will be noted that the main bar is nowhere reduced in section, and that the stirrups may be attached with any arrangement of spacing desired, that they may be of any length desired and that they may be set at any angle with the main bar that is desired. A point to be noted also is the facility offered for attaching spacing rods either to hold the main bars above the lugging boards or to preserve their distance apart laterally or vertically.

Fig. 3 is a sketch showing the arrangement for column reinforcement, and Fig. 4 is another sketch showing the arrangement for a hollow wall or partition. These two sketches are so clear that extended description is unnecessary.

Fig. 2. Reinforcing Unit for Girders.

In conclusion it may be noted that it is possible either to assemble the reinforcement as shown at the shops and ship it to the work, or simply to ship the bars, rods and mesh in suitable quantities and do the assembling at the site of the work. The apparatus required is very simple, being merely that necessary for binding and cutting the rods and a drop press for clamping together the lips of the grooves in the main b[illegible]

The form of reinforcement described is the invention of Mr. J. G. Golding, of Washington, D. C., well known as the inventor of expanded metal. The Monolith Steel Co., Colorado Bldg., Washington, D. C., is the licensee of the United States patents for this invention.

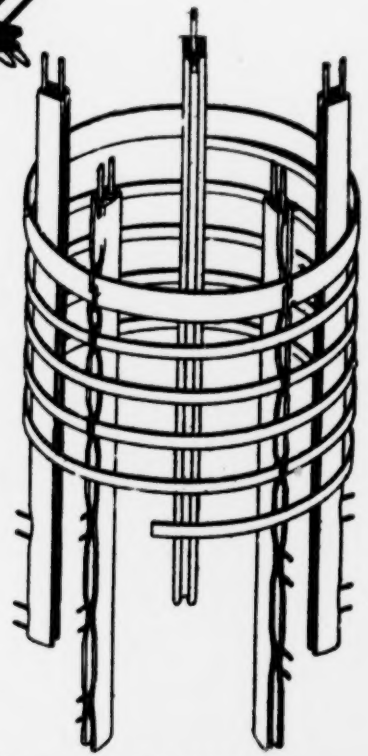


Fig. 3. Reinforcing Unit for Columns.

426

DEFENDANT'S EXHIBIT GG
2—390

UNITED STATES OF AMERICA,
DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all to whom these presents shall come, Greeting:

THIS IS TO CERTIFY that the annexed is a true copy from the Records of this Office of the File Wrapper and Contents in the matter of the

Letters Patent of
George E. Vandenburgh,

Number 841,741, Granted January 22, 1907,
for
Improvement in Reinforcing-Bars.

IN TESTIMONY WHEREOF I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington, this 17th day of March, in the year of our Lord one thousand nine hundred and seventeen and of the Independence of the United States of America the one hundred and forty-first.

(Seal)

F. W. H. CLAY,
Acting Commissioner of Patents.

2—437

NUMBER (SERIES OF 1900).

315959 1906 DIV. 33

PATENT No. 841741 (EX'R'S BOOK) 234

Name George E Vandenburgh 13

Washington

County of

D. C.

Invention Reenforcing Bars

Division of App., No. , 190

PARTS OF APPLICATION FILED , filed

Reissued Aug. 15, 16 No. 14,182

	ORIGINAL.	RENEWED.
Petition	May 9, 1906	, 190
Affidavit	" ", 1906	, 190
Specification	" ", 1906	, 190
Drawing	" ", 1906	, 190
Model or Specimen	, 190	, 190
First Fee Cash $ 15	May 9, 1906	, 190
" " Cert.	, 190	, 190
Appl. filed complete	May 9, 1906	, 190
Examined W A Cowles	Nov. 26 1906	, 190
Countersigned	H B Burch	, 190
	For Commissioner.	For Commissioner.
Notice of Allowance	Dec. 3 1906	, 190
Final Fee Cash $20	Dec. 29, 1906	, 190
" " Cert.	, 190	, 190
Patented	January 22	, 190

Attorney E B Stocking

City

Issue Div.

Associate Attorney

Name

3 Patent No

Serial No

Date of Patent

$15.—RECEIVED Serial No. 315959 Paper No. ½
MAY 9 1906 Application
CHIEF CLERK U. S. PATENT OFFICE

PETITION.

U. S. PATENT OFFICE
MAY 11 1906
DIVISION 33

To the Commissioner of Patents:

Your petitioner George E. Vandenburgh citizen of the United States, residing at Washington, District of Columbia, whose Post Office address is 921 9th St. Washington, D. C. prays that Letters Patent may be granted to him for the improvements in Reenforcing Bars as set forth in the annexed specification.

And he hereby appoints E. B. STOCKING, of Washington, D. C., Registered No. 183, attorney, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the Patent, to sign the drawings, and to transact all business in the Patent Office connected therewith.

George E Vandenburgh

SPECIFICATION.

To all Whom it may Concern:

Be it Known, That I, George E. Vandenburgh citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful improvements in Reenforcing Bars of which

the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to a reenforcing bar particularly adapted for cement and concrete construction wherein the bar is embedded in the plastic body to be supported thereby

The invention has for an object to provide a reenforcing bar with one or more spirally disposed coils secured to the bar so as to provide an extended area of contact adapted to resist strain longitudinally and laterally of the bar and to form a truss within the body of concrete or other plastic material which provides the maximum of supporting strength in the arch or surface to be formed.

Other and further objects and advantages of the invention will be hereinafter set forth and the novel features thereof defined by the appended claims.

In the drawing:—

Figure 1 is a vertical section showing the bar applied to supporting girders or beams;

Figure 2 is an enlarged vertical section on the line 2 - 2, Figure 1;

Figure 3 is a detail perspective of the primary and secondary coils shown in Figure 1;

Figure 4 is a similar view of a modified form using one coil;

Figure 5 is a detail plan of the form shown in Figure 3, and

Figure 6 is an elevation of two meshing coils used for girder and column construction.

Like numerals of reference indicate like parts in the several figures of the drawings.

The numeral 1 designates a bar which may be of any desired construction or configuration and supported in any preferred manner, for instance, when used in arch construction it is adapted to rest upon the base of the beams or girders 2 sufficiently above the lower surface thereof to provide for the facing of the concrete or cement beneath the lower face of the bar. The coils 4 are secured to the bar in any desired manner, for instance, as hereinafter described and the plastic material or cement filling 5 applied so as to surround the coils and bar and embed the same therein to form a truss construction.

The bar may be provided with a primary coil 6 extending in one direction, as shown in Figure 4, which is sufficient in light construction, but when a heavier construction is to be used a secondary coil 7 is provided which extends in the opposite direction to the coil 6 and through the same so as to cross beneath the coil 6 at a point directly above the bar, thus providing a construction in which all lateral pull or strain of the coil is avoided owing to the equalization thereof by the oppositely extending coils and the tendency of the coils to move or flatten towards the face of the bar resisted. This preferred construction is shown in Figures 1 and 3, and it is also desirable that both of the coils be deflected away from the center of the bar, as shown in Figure 1 as the greatest supporting strain carried by the arch is at the center thereof and this deflection therefore resists such strain and tends to draw the coils upward into a position at right angles to the bar.

As a preferred means of securing the coils to the

bar I have shown a series of kerfs 8 in one face of the bar inclined away from the center of the bar toward the opposite ends thereof, and the coils are seated within these kerfs and held therein by means of the integral spurs 9 which are forced downward upon the coils when inserted and permanently retain them in position.

In Figure 6 a modified application of the invention is shown where two of the bars are disposed parallel to each other with their coils intermeshing for use in column or girder construction wherein such a construction provides the maximum of strength with the minimum of weight in the reenforcing material.

In the operation of the invention it will be seen that the bar supporting the coil resists any movement thereof longitudinally of the bar and provides the necessary strength upon which the truss structure formed by the coils is carried. These coils being extended in opposite directions and embedded in the material provide the maximum strength to resist either lateral or longitudinal pressure with the medium weight and quantity of material as owing to their opposite direction of curvature they effectually oppose the strain placed thereon while their deflection toward the opposite ends of the bar resists the central downward strain of the arch. It will be seen that this form of bar is very simple and economical in construction while embodying the greatest efficiency in use. This bar although described in connection arch and column construction is adapted for use in any character of metal reenforced concrete or cement construction.

Having now described my invention and set forth its merits, what I claim and desire to secure by Letters Patent is:—

~~Sub. B~~ 1. ~~A reenforcing bar provided with a plu-~~
Oct 30, '06 rality disposed coil secured thereto and having
Sept 27-06 free coils disposed beyond said bar.

2. A reenforcing bar provided with a spir-
" " " ally disposed coil secured thereto and extended
Oct. 30, 06 free of said bar and a secondary spirally dis-
Sept 27 '06 posed coiled strands secured to the bar and extending in the opposite direction to the first mentioned coil.

~~Canceled~~ 3. ~~A reenforcing bar provided upon one~~
Oct 30, '06 edge with a series of kerfs and integral spurs,
" " " forming an enclosing wall thereof and a spiral coil disposed in said kerfs and retained by said spurs.

4. A reenforcing bar provided with a series of kerfs at opposite sides of the center thereof and disposed toward the ends of the bar, op-
" " " positely disposed coils seated in said kerfs, and spurs carried by the bar and forming an enclosing wall for retaining the coils in said kerfs.

5. A reenforcing bar provided at opposite sides of its center with spiral circular coils
Sept. 27-06 secured thereto to extend free of the bar and deflected in opposite directions from the center of the bar.

6. A reenforcing bar provided at opposite sides of its center with spiral coils secured thereto and deflected in opposite directions from the center of the

bar, and a secondary spiral coil secured to the bar and extended in the opposite direction to the first mentioned coil throughout the length thereof.

In Testimony Whereof, I affix my signature in presence of two witnesses.

George E Vandenburgh

Alfred T. Gage
John L. Fletcher

OATH.

District of Columbia
City of Washington—SS.

George E. Vandenburgh the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States and resident of Washington, District of Columbia, and that he verily believes himself to be the original, first, and sole inventor of the improvements in

Reenforcing Bars

described in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in the United States of America or any foreign country before his invention or discovery thereof or more than two years prior to this application; or in public use or on sale in the United States for more than two years prior to this application, and that no application for foreign patent has been filed by him or his legal representatives or assigns in any foreign country.

George E Vandenburgh

Sworn to and subscribed before me this 7th day of May 1906

(Seal)

John L. Fletcher.
Notary Public,
D. C.

2-260 IAD

Div. 33 Return 164 Paper No. 1 (Rej.)

Address "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON Sept. 25, 1906.

MAILED " " "

G. E. Vandenburgh, DIV. 33.
Care E. B. Stocking,
Washington, D. C.

Please find below a communication from the EXAMINER in charge of your application, for "Reenforcing Bars", filed May 9, 1906, Serial No. 315,959.

F. I. Allen
Commissioner of Patents.

Claim 1 is rejected on the Swiss patent to:
Muuch, 19,271, C. & F., C. & M.
Claim 2 is rejected on:
Mueser, 815,617, Mar. 20, 1906, M. R.
Claim 3 is rejected on the Swiss patent above in view of: Peabody, 805,663, Nov. 28, 1905, M. R.
Claim 4 is rejected on Peabody.
Claim 5 is rejected on the Swiss patent above.
G.C.W.

W A Cowles
Examiner Division 33.

Serial No. 315,959 Paper No. 2

U. S. PATENT OFFICE
SEP 27 1906
DIVISION 33. AMENDMENT A

IN THE UNITED STATES PATENT OFFICE.

G. E. Vandenburgh.
Reenforcing Bar. Serial No. 315,959.
Filed May 9, 1906. Room No. 164.

Last Official Action Sept. 25, 1906.

The Commissioner of Patents,
Sir:—

I hereby amend the above entitled application in the following particulars:—

Claim 1, line 2, after "thereto" insert:—
—*and having free coils disposed beyond said* bar—

Claim 2, line 2, change "coil" to—coiled strand—
After "thereto" insert: —*and extend free of said bar*— Line 3, before "extending" insert: —*secured to the bar and*—

Claim 3, line 2, after "spurs" insert:
—*forming an enclosing wall thereof*—
Claim 5, line 2, after "spiral" insert: —*circular*—
After "thereto" insert: —*to extend free of the bar*—

Claim 4, line 4, after "bar" insert:
—*and forming an enclosing wall*—

ARGUMENT.

The claims have been amended to clearly distinguish over the Swiss patent cited which does not show the spirally coiled strand secured to the bar to prevent lateral movement thereon, and does not

have the free coils disposed beyond the bar to be embedded in the concrete and form an arch structure of practically the diameter of the coils. In the Swiss patent in Figure 1 a spiral coil is not shown, but the wire is coiled over an oval form as shown in Figure 2a. In neither instance can the extended area of applicant's spiral be secured, and in the use of such a spiral it is necessary that it be secured to the bar to prevent lateral displacement when tamping the material in position. The reference device shows a different form of brace where the wire simply extends between two parallel bars and is only practically of the width of these bars and the diameter of wire thereon. The patent to Mueser merely shows the integral ribs formed on the bar and not a strand extending free thereof for the purpose of applicant's invention so that claim 2 is now believed to clearly define over this patent which is not intended or adapted for the purpose of this invention. The patent to Peabody does not show any spurs forming an enclosing wall for the kerf and adapted thereby to retain the coil in position. As recited in claims 3 and 4 this is a novel means of securing the coils to the bar and should be allowed. An independent discussion of the claims is not believed to be necessary in view of the amendments and the foregoing statement of differences over the references.

Respectfully submitted,

E B Stocking
Attorney

September 27, 1906.

2-260 IAD

Div. 33 Room 164 Paper No. 3 (Rej.)

Address "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON Oct. 24, 1906.

MAILED " " "

G. E. Vandenburgh,
Care E. B. Stocking,
Washington, D. C.

DIV. 33.

Please find below a communication from the EXAMINER in charge of your application for "Reenforcing Bars", filed May 9, 1906, Serial No. 315,959.

F. I. Allen
Commissioner of Patents.

This case has been considered as amended Sept. 27, 1906.

Claims 1, 3, 4 and 5 are rejected on the Swiss patent of record, in view of:

Kahn, 768,284, Aug. 23, 1904 M. R.,

which shows shear arms attached to the tension bar by being seated in saw-kerfs and grooves and the metal of the bar compressed by the shear arms to maintain the same in its seat.

Claim 6 is allowed.

Does applicant wish the word "coil" in both

places where it occurs in line 2 of claim 2 to be changed to *coiled strand?*

G.C.W.

W. A. Cowles
Examiner Division 33.

U. S. PATENT OFFICE
OCT 31 1906
DIVISION 33.

Serial No. 315,959
Paper No. 4
AMENDMENT B

APPLICATION ROOM
OCT 30 1906
U. S. PATENT OFFICE

IN THE UNITED STATES PATENT OFFICE.

G. E. Vandenburgh.
Reenforcing Bar.
Filed May 9, 1906.

Serial No. 315,959.
Room No. 164.

Last Official Action Oct. 24, 1906.

The Commissioner of Patents,

Sir:—

I hereby amend the above entitled application in the following particulars:—

Claim 2, line 2 change "coils" (2nd occurrence) to—coiled strands—

Cancel claims 1, 3, 4 and 5 and insert—

---

1. In a reenforcing bar, a spiral coil rigidly secured thereto at two points in each convolution thereof and extended beyond and free of said bar at the opposite side therefrom to the securing point.

2. In a reenforcing bar, a spiral coil rigidly secured thereto at two points in each convolution there-

of and extended beyond and free of said bar at the opposite side therefrom to the securing point, said coils being deflected in opposite directions from the center of the bar toward the ends thereof.

3. A reenforcing bar provided upon one end with a series of kerfs each having an integral overlapping spur, and a coil disposed in said kerfs, each convolution thereof being retained beneath one of said spurs.

4. A reenforcing bar provided upon one edge with a series of kerfs disposed diagonally to the length of the bar each having an overlapping integral spur projected toward the center of the bar, coil.

Nov. 21-06

ARGUMENT.

It is submitted that the claims as now presented clearly distinguish over the references of record which do not disclose applicant's bar. The Swiss patent which is relied upon by the Examiner shows windings carried by parallel rods and not secured to either of the rods so that there is nothing except the frictional contact of the wire to retain the same against longitudinal movement on the rods, or a lengthwise sliding of the bar or wire coiled thereon. This patent does not show a fair instance of a spiral coil having every convolution extended beyond the bar, and even if one of the rods be removed would not anticipate applicant's invention because the remaining rod not being attached to the coil could not retain it in operative position. The Examiner will certainly concede that a structure which is in-

operative to accomplish applicant's functions or advantages cannot be a reference therefor, and even though the Swiss patent be reconstructed it lacks the features now defined by applicant's claims 1 and 2. In this connection is should be noted that Figures 1 and 2 of this patent are separate forms of the invention, as shown at 1a and 2a so that the Swiss patent does not shows the wire deflected toward the opposite ends of the bar, and surely each convolution of the wire is not secured to the bar at two points. By applicant's structure the wire is held against any uncoiling by slipping of the bar, and also against longitudinal movement relative to the bar so that the spiral strands when embedded in the concrete form a structure extending continuously from the center toward the opposite ends of the bar the strands being so disposed that the coil of one overlapping the supporting area of another thus securing a practically continuous support through the body of the concrete.

While the patent to Kahn last cited shows a spur pressed upward from the bar, it certainly does not show applicant's kerf extended inward from one edge thereof having the overlapping spur by means of which the coil is retained entirely within the area of the bar and hooked in the kerf so that it cannot be backed out or disengaged therefrom in packing the concrete material in position. The structure of spur which overlaps the coil when in position absolutely retains the latter against any movement rela-

tive to the reenforcing bar and being novel should be granted protection.

Respectfully,

E B Stocking
Attorney.

October 30, 1906.

2-260 TJ

Div. 33 Room 164 Paper No. 5- (Let)

Address "The Commissioner of Patents, Washington, D. C." and not any official by name.

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON November 20, 1906
MAILED " " "

George E. Vandenburgh, DIV. 33.
C/o E. B. Stocking,
Washington, D. C.

Please find below a communication from the EXAMINER in charge of your application, Serial No. 315,959, filed May 9, 1906, For "Reenforcing Bars.

F. I. Allen
Commissioner of Patents.

Responsive to amendment of October 30, 1906.

Claim 2 has been re-numbered 5.

In line 4 of claim 4, "coiled" should be *coil.*

The case otherwise, is in condition for allowance.

G. C. W.

W A Cowles
Examiner Division 33.

Serial No. 315,959 Paper No. 6

S. PATENT OFFICE
NOV 21 1906
DIVISION 33.

AMENDMENT C.

IN THE UNITED STATES PATENT OFFICE.

George E. Vandenburgh.
Reenforcing Bar
Filed May, 9 1906.

Serial No. 315,959.
Room No. 164.

Last Official Action Nov. 20, 1906.

The Commissioner of Patents,

Sir:—

I hereby amend the above entitled application in the following particulars:—

Claim 4, line 4, change "coiled" to —coil—

ARGUMENT.

The formal objections having been removed this case is now in condition for allowance.

Respectfully,

E B Stocking
Attorney.

November 21, 1906.

SM Issue Division

All communications should be addressed to Serial No. 315,959 "The Commissioner of Patents, Washington, D. C."

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D., C.

Dec. 3, 1906.

George E. Vandenburgh,
C/o E. B. Stocking,
Washington, D. C.

Sir: Your APPLICATION for a patent for an IMPROVEMENT IN

Reenforcing Bars,

filed May 9, 1906, has been examined and ALLOWED.

The final fee, TWENTY DOLLARS, must be paid, and the Letters Patent bear date as of a day not later than SIX MONTHS from the time of this present notice of allowance.

If the final fee is not paid within that period the patent will be withheld, and your only relief will be by a renewal of the application, with additional fees, under the provisions of Section 2897, Revised Statutes. The office aims to deliver patents upon the day of their date, and on which their term begins to run; but do this properly applicants will be expected to pay their final fees at least TWENTY DAYS prior to the conclusion of the six months allowed them by law. The printing, photolithographing, and engross-

In Remitting the Final Fee Give the Serial Number at the Head of this Notice.

Uncertified Checks Will Not Be Accepted.

ing of the several patent parts, preparatory to final signing and sealing, will consume the intervening time, and such work will not be done until after payment of the necessary fees.

When you send the final fee you will also send, DISTINCTLY AND PLAINLY WRITTEN, the name of the INVENTOR and TITLE OF INVENTION AS ABOVE GIVEN, DATE OF ALLOWANCE (which is the date of this circular), DATE OF FILING, and, if assigned, the NAMES OF THE ASSIGNEES.

If you desire to have the patent issued to ASSIGNEES, an assignment containing a REQUEST to that effect, together with the FEE for recording the same, must be filed in this office on or before the date of payment of final fee.

After issue of the patent uncertified copies of the drawings and specifications may be purchased at the price of FIVE CENTS EACH. The money should accompany the order. Postage stamps will not be received.

Respectfully,

F. I. Allen
Commissioner of Patents.

2—327.

$ 20/ RECEIVED
DEC 29 1906 Y

CHIEF CLERK U. S. PATENT OFFICE

MEMORANDUM

of

FEE PAID AT UNITED STATES PATENT OFFICE

(Be careful to give correct Serial No.)

Serial No. 215,959 190

INVENTOR: George E. Vandenburgh

Patent to Be Issued to Per record

Name of Invention, as Allowed: Reenforcing Bar

Date of Payment:

Fee: Final $20.

Date of Filing: May 9, 1906

Date of Circular of Allowance: December 3, 1906

The Commissioner of Patents will please apply the accompanying fee as indicated above.

E B Stocking
Attorney.

Send Patent to Issue Division.

SM

2—191

Address only "The Commissioner of Patents, Washington, D. C."

Serial No. 315,959

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON

Dec. 29, 1906.

George E. Vandenburgh,
C/o E. B. Stocking,
Washington, D. C.

Sir:

You are informed that the final fee of TWENTY DOLLARS has been received in your application for Improvement in

Reenforcing Bar.

Very respectfully,

F. I. Allen
Commissioner of Patents.

1906

CONTENTS:

Print			
1/2	Application 1 paper.		
1.	Rejection	Sept. 25,	1906
2.	Amendment A	" 27	"
3.	Rejection	Oct. 24	"
4.	Amendment B	" 30	"
5.	Office Letter	Nov. 20	"
6.	Amendment C	" 21	"

72 MASONRY
METAL-REINFORCED

TITLE:
Improvement in Reenforcing Bars.

2—390.

UNITED STATES OF AMERICA,
DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all to whom these presents shall come, Greeting:

THIS IS TO CERTIFY that the annexed is a true copy from the Records of this Office of the File Wrapper and Contents in the matter of the

Reissue Letters Patent of
George E. Vandenburgh,

Number 14,182, Granted August 15, 1916,

for

Improvement in Reinforcing Bars.

IN TESTIMONY WHEREOF I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington, this 17th day of March, in the year of our Lord one thousand nine hundred and seventeen and of the Independence of the United States of America the one hundred and forty-first

(Seal) F. W. H. Clay.

NUMBER (Series of 1915),

(EX'R'S BOOK) 7 - 143

107203 1916 17

DIV. 33 REISSUE No. 14182

Name George E. Vandenburgh

of San Francisco,

, 191 County of

State of California

Invention Reinforcing Bars

granted

PARTS OF APPLICATION FILED

Petition	July 1	, 1916
Affidavit	" "	, 1916
Specification	" "	, 1916
Drawing	" "	, 1916
Old Patent	July 1	, 1916
Abstract of Title (Ordered)	" "	, 1916
Fee Cash $30	July 1	, 1916
Fee Cert. Dep.		, 191
Appl. filed complete	July 1	, 1916

Division of Original Patent No.

Original Patent No. 841,741 Date Jan. 22, 1907

Examined W A Cowles July 19 , 1916

Notice of Allowance JUL 21 1916 , 1916

By Commissioner.

Reissued August 15 , 1916

Attorney Carlos P. Griffin,

704 Pacific B'ld'g, San Francisco, Calif.

Associate Attorney
(No. of Claims Allowed 7)
Title as Allowed Reinforcing Bars
3 (Cl. 72 - 112)

Serial No. 107203 Paper No. 1
Application.

U. S. PATENT OFFICE $30.00 REC'D
JUL 6 1916 JUL 1 1916 M O J.
DIVISION 33. C. C. U. S. PAT. OFFICE

To the Commissioner of Patents:

Your Petitioner, George E. Vandenburgh, a citizen of the United States and a resident of San Francisco, in the county of San Francisco, and State of California, whose post-office address is General Delivery, San Francisco, California, prays that he may be allowed to surrender the letters patent for an improvement in Reinforcing Bar, granted to him Jan. 22, 1907, whereof he is now the sole owner, and that letters patent may be reissued to him for the same improvement upon the annexed amended specification. With this petition is filed an abstract of title, duly certified, as required in such cases; and he hereby appoints Carlos P. Griffin, (Reg. No. 7830), 704 Pacific Building, San Francisco, California, his attorney, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments herein, to sign the drawings, to receive the patent and to transact all business in the Patent Office connected therewith.

Signed at San Francisco, in the county of San

Francisco, and the State of California, this *24th* day of June, 1916.

George E. Vandenburgh.

(Revenue Stamp)

To All Whom It May Concern:

Be it known that I, George E. Vandenburgh, a citizen of the United States, and recently of Washington, District of Columbia and now residing at San Francisco, California, have invented certain new and useful Improvements in Reinforcing-Bars, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to a reinforcing-bar particularly adapted for cement and concrete construction wherein the bar is embedded in the plastic body to be supported thereby.

The invention has for an object to provide a reinforcing-bar with one or more spirally-disposed coils secured to the bar so as to provide an extended area of contact adapted to resist strain longitudinally and laterally of the bar and to form a truss within the body of concrete or other plastic material which provides the maximum of supporting strength in the arch or surface to be formed.

Other and further objects and advantages of the invention will be hereinafter set forth, and the novel features thereof defined by the appended claims.

In the drawings, Figure 1 is a vertical section showing the bar applied to supporting girders or beams. Fig. 2 is an enlarged vertical section on the line 2 2, Fig. 1. Fig. 3 is a detail perspective of the

primary and secondary coils shown in Fig. 1. Fig. 4 is a similar view of a modified form using one coil. Fig. 5 is a detail plan of the form shown in Fig. 3, and Fig. 6 is an elevation of two meshing coils used for girder and column construction.

Like numerals of reference indicate like parts in the several figures of the drawings.

The numeral 1 designates a bar which may be of and desired construction or configuration and supported in any preferred manner. For instance, when used in arch construction it is adapted to rest upon the base of the beams or girders 2 sufficiently above the lower surface thereof to provide for the facing of the concrete or cement beneath the lower face of the bar. The coils 4 are secured to the bar in any desired manner—for instance, as hereinafter described—and the plastic material or cement-filling 5 applied so as to surround the coils and bar and embed the same therein to form a truss construction.

The bar may be provided with a primary coil 6, extending in one direction, as shown in Fig. 4, which is sufficient in light construction; but when a heavier construction is to be used a secondary coil 7 is provided, which extends in the opposite direction to the coil 6 and through the same so as to cross beneath the coil 6 at a point directly above the bar, thus providing a construction in which all lateral pull or strain of the coil is avoided, owing to the equalization thereof by the oppositely-extending coils and the tendency of the coils to move or flatten toward the face of the bar resisted. This preferred construc-

tion is shown in Figs. 1 and 3, and it is also desirable that both of the coils be deflected away from the center of the bar, as shown in Fig. 1, as the greatest supporting strain carried by the arch is at the center thereof, and this deflection therefore resists such strain and tends to draw the coils upward into a position at right angles to the bar.

As a preferred means of securing the coils to the bar I have shown a series of kerfs 8 in one face of the bar inclined away from the center of the bar toward the opposite ends thereof, and the coils are seated within these kerfs and held therein by means of the integral spurs 9, which are forced downward upon the coils when inserted and permanently retain them in position.

In Fig. 6 a modified application of the invention is shown where two of the bars are disposed parallel to each other with their coils intermeshing, for use in column or girder construction, wherein such a construction provides the maximum of strength with the minimum of weight in the reinforced material.

In the operation of the invention it will be seen that the bar supporting the coil resists any movement thereof longitudinally of the bar and provides the necessary strength upon which the truss structure formed by the coils is carried. These coils being extended in opposite directions and embedded in the material provide the maximum strength to resist either lateral or longitudinal pressure with the minimum weight and quantity of material, as owning to their opposite direction of curvature they effectually oppose the strain placed thereon, while their

deflection toward the opposite ends of the bar resists the central downward strain of the arch.

It will be seen that this form of bar is very simple and economical in construction while embodying the greatest efficiency in use. This bar, although described in connection with arch and column construction, is adapted for use in any character of metal, reinforced concrete, or cement construction.

Ex.Amdt

Having now described my invention and set forth its merits, what I claim, and desire to secure by Letters Patent, is:—

1. A concrete reinforcing consisting of a bar having a plurality of integral spurs, and a spiral coil permanently secured thereto by having the spurs bent down on the several coils, the coils extending beyond and free of the bar at the opposite side therefrom to the securing point.

2. A concrete reinforcing consisting of a bar having integral means to secure a coil thereto and a coil permanently secured to the bar in each convolution and extended beyond and free of said bar at the opposite side therefrom to the securing point.

3. A reinforcing-bar provided upon one edge with a series of kerfs each having an integral overlapping spur, and a coil disposed in said kerfs, each convolution thereof being retained beneath one of said spurs.

4. In a reinforcing-bar, a spiral coil permanently secured thereto by spurs bearing on each convolution thereof and extended beyond and free of said bar at the opposite side therefrom to the securing-point

said coils being deflected in opposite directions from the center of the bar toward the ends thereof.

5. A reinforcing-bar provided upon one edge with a series of kerfs disposed diagonally to the length of the bar each having an overlapping integral spur projected toward the center of the bar, and a coil disposed in said kerfs and retained beneath said spurs.

6. A reinforcing bar provided with a spirally-disposed coil secured thereto and extended free of said bar, and a secondary spirally-disposed coiled strain secured to the bar and extending in the opposite direction to the first mentioned coil.

7. A reinforcing-bar provided at opposite sides of its center with spiral coils secured thereto and deflected in opposite directions from the center of the bar, and a secondary spiral coil secured to the bar and extended in the opposite direction to the first-mentioned coil throughout the length thereof.

In Testimony Whereof I have hereunto set my hand this 24th day of June, 1916.

George E. Vandenburgh.

Approved
Under Order 2255,
July 19, 1916.
Ballard L. Ex.

OATH.

State of California
City and County of San Francisco—ss.

George E. Vandeburgh, the above named petitioner, being duly sworn, deposes and says that he does verily believe himself to be the original, first and sole inventor of the improvement set forth and claimed in the foregoing specification and for which improvement he solicits a patent; that deponent does not know and does not believe that said improvement was ever before known or used before his invention thereof; that deponent is a citizen of the United States of America, and resides at San Francisco, in the county of San Francisco, and State of California; that deponent verily believes that the letters patent referred to in the foregoing petition and specification and herewith surrendered are inoperative for the reason that the specification is defective and insufficient, and that such defect and insufficiency consists in the omission therefrom of present claims 1, 2, 3 and 4, and in the use of the word "rigidly" in line 1, original claims 1 and 2, and in the statement that the coils are secured to the reinforcing bar at "two points in each convolution", lines 2 and 3, original claims 1 and 2, as well as in the use of the word "end" in line 2, claim 3; that the original specification in no place makes use of the word "rigidly" with respect to the manner of securing the coils to the bar, and that the bars and coils never were rigidly secured together in any of applicant's constructions, but that they were permanently se-

cured together only, as stated in lines 85 and 86 of the printed copy of the specification; that there is an error in the use of said words "two points" in that while a single coil is secured to the bar at two points in each convlution that where there are a plurality of coils there is only one more securing point than there are coils, and with respect to the word "end" used in line 2 of original claim 3, that said error is not in accordance with the facts, which are that the spurs or kerfs are on the *edge* of the bar and no where shown to be on the "end" of the bar in the original drawing, and that the four claims substituted for claims 1, 2 and 3 are more limited than the claims appearing in the specification; that deponent further says that the error which renders said letters patent so inoperative arose from inadvertence, accident or mistake and without any fraudulent or deceptive intention upon the part of deponent, in that he was personally unfamiliar with the prosecution of patent cases and did not fully understand that words used in the claims must be supported by wording in accordance with the specification and that such error arose with respect to claim 1 because of the purely accidental use by the attorney prosecuting the original application of words not in accordance with the construction, and with respect to claim 3 applicant believes that the word "end" was a mere typographical error for the word *edge*, and he believes with respect to claim 1 that he has claimed as his invention more than he had a right to claim as new; that as soon as said errors came to his knowledge and

attention he applied for this reissue, and that he is the sole owner of said letters patent and hereby offers to surrender the original letters patent.

George E. Vandenburgh.

Subscribed and sworn to before me, a Notary Public in and for the City and County of San Francisco, and State of California, this 24th day of June, 1916.

I. H Anderson

(Seal) Notary Public in and for the City and County of San Francisco, State of California. My Commission expires December 27, A. D. 1918.

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Whereas George E. Vandenburgh,
of
Washington, District of Columbia,

Has presented to the Commissioner of Patents a petition praying for the Grant of Letters Patent for an alleged new and useful improvement in

Reinforcing-Bars,

A description of which invention is contained in the specification of which a copy is hereunto annexed and made a part hereof, and has complied with the various requirements of Law in such cases made and provided, and

Whereas upon due examination made the said Claimant is adjudged to be justly entitled to a patent under the Law.

Now therefore these LETTERS PATENT are to grant unto the said George E. Vandenburgh, his heirs or assigns for the term of Seventeen years from the twenty-second day of January one thousand nine hundred and seven the exclusive right to make, use and vend the said invention throughout the United States and the Territories thereof.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this twenty-second day of January in the year of

SURRENDERED
SURRENDERED
SURRENDERED

our Lord one thousand nine hundred and seven and of the Independence of the United States of America the one hundred and thirty-first.

SURRENDERED

(Seal) **F. I. Allen**
Commissioner of Patents.

MAIL ROOM
JUL 1 1916
U. S. PATENT OFFICE.

(Printed Letterhead Omitted)

SAN FRANCISCO

June 26 1916

Hon. Commissioner of Patents
Washington, D. C.

Sir: This patent was omitted from a reissue application mailed this day.

Respectfully
C. P. Griffin

C. P. Griffin,
103510

2—401.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C.

July 6, 1916.

Application of *George E. Vandenburgh, Washington, D. C.*, for Reissue of Letters Patent, No. *841,741* dated *January 22, 1907* for improvement in *"Reinforcing-Bar."*

I certify that careful search has been made in the Digest of Assignments in this Division and that no assignment of undivided interest is found of record under or relating to the aforesaid Letters Patent up to and including *June 16, 1916*

Willis B. Magruder
Chief of Assignment Division.

Serial No. 107203 Paper No. 1
Ex Amendment.
2—254

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON, D. C.

July 19, 1916

In compliance with the provisions of order No.

1718, dated June 8, 1907, and which reads as follows:

It is hereby ordered that, except by formal amendment duly signed or as hereinafter provided, no corrections, erasures, or interlineations be made in the body or written portions of the specification or of any other paper filed in an application for patent.

Obvious informalities in the wording of the specification may be corrected by the examiner, but said correction must be in the form of an amendment, approved by the Principal Examiner in writing, placed in the file, and made a part of the record. The changes specified in the amendment will be entered by the clerk in the regular way.

It is directed that no other changes be made by any person in any record of this office without the written approval of the Commissioner of Patents.

Attorneys, employees of the Patent Office, and all others will be held to strict accountability for any violation of this order.

Thomas Ewing
Commissioner.

The following changes are made in—
Application Serial No. 107,203 (Reissue)
of George E. Vandenburgh.
Page 3, line 19, after "connection"
insert with.

.....

Examiner, Division.....

2—184

Address Only
The Commission of Patents
Washington, D. C.

Serial No. 107,203

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON

July 21, 1916

George E. Vandenburgh
PATENT
AUG 15 1916
WILL ISSUE

Sir:

Your application for Reissue of Patent No. 841,741 for improvement in Reinforcing Bars has been examined and allowed.

The patent will be forwarded to you as soon as practicable, in due order of business.

Very respectfully,
Thomas Ewing
Commissioner of Patents.

Carlos P. Griffin
704 Pacific Bldg
San Francisco, Cal.

CLASSIFICATION.

1916
Class
CONTENTS:
Application papers.
1. Amendment.

(Order dismissing bill ent. Oct. 18th, 1920, by Judge Westenhaver)

George E. Vandenburgh)
vs.) No. 500. Equity.
Truscon Steel Company)

This cause having been submitted to the Court on the 9th day of June, 1920 upon the pleadings and proofs, and having been argued by counsel for the respective parties, and due deliberation having been had, the Court finds that the equities are with the defendant.

It is, therefore, ordered adjudged and decreed that the said bill of complaint herein be, and the same is hereby dismissed at complainant's costs.

IN THE DISTRICT COURT OF THE UNITED STATES NORTHERN DISTRICT OF OHIO EASTERN DIVISION

GEORGE E. VANDENBURGH, Complainant,)
vs.)IN EQUITY
TRUSCON STEEL COMPANY, Defendant.) No. 500

WESTENHAVER, District Judge.

Plaintiff's bill is in the usual form, charging infringement by defendant of United States Re-issue Letters Patent No. 14,182, granted to him August 15, 1916, being a re-issue of Letters Patent No. 841,471, granted January 22, 1907. The subject of the patent is for a reinforcing bar to be used in concrete construction. On this hearing, claims 1 and 3 only are in issue and relied on. The defenses are invalidity for lack of invention, and non-infringement.

This re-issue patent has been the subject of previous litigation in the Second and Third Circuits. Circuit Judge Hough, May 13, 1918, held, in effect, that claims 1 and 2 of the re-issue patent are invalid if the change made therein from the words "rigidly secured" of the original patent, to "permanently secured" of the re-issue claims embody a different meaning than the original; that claim 3 was not infringed by a construction substantially, if not exactly, similar to the construction here involved; and, finally, that the only invention disclosed by the specifications is the exact construction described and pictured in Figs. 1 and 6. On appeal, the Circuit Court

of Appeals of the Second Circuit held that claims 1 and 2 of the re-issue were invalid as too broad, and, in effect, that claim 3 was valid and infringed. The opinion is brief and contains no review of the prior art. It seems to assume that Judge Hough had disposed of the controversy below on the ground only of non-infringement; and seems to assume rather than to attempt to demonstrate that the feature found to be novel as disclosed by the specifications and covered by claim 3 was, in view of the prior art, patentably novel.

In the Third Circuit, District Judge Orr, December 6, 1918, also held that claims 1 and 2 were invalid because too broad, as stated in the opinion of the Court of Appeals, Second Circuit, and also held that claim 3, in view of the prior art, was invalid for lack of invention. On appeal, the Circuit Court of Appeals agreed that claims 1 and 2 were invalid because too broad, but, assuming the validity of claim 3, held that, being limited, as it must, in view of the prior art, to the specific construction therein disclosed and claimed, was not infringed by a construction somewhat different from the construction here involved. We do not understand this opinion as deciding that claim 3 was valid.

On the hearing before me, the controversy was directed almost entirely to the validity of claim 3, although claim 1 was likewise in issue and relied on. In view of the attitude thus assumed by plaintiff's counsel, and the further fact that all the judges who have heretofore considered and passed on claims 1 and 2 have held them to be invalid because too broad,

I shall adopt that conclusion without further statement of my reasons than to say that I fully agree, both in the conclusion reached and in the reasons given to support it.

Plaintiff's invention is described in his patent as being a reinforcing bar particularly adapted for cement and concrete construction wherein the bar is embedded in the plastic body to be supported thereby. Fig. 6 discloses an adaptation of this reinforcing bar for column or pillar construction, but no contention is made that this is infringed by defendant. Fig. 4, plaintiff contends, also discloses an adaptation of this reinforcing bar for column construction, and that this is also infringed. This contention is disputed, defendant insisting that Fig. 4 is a detail only of a simple and inexpensive form of the beam construction disclosed in Fig. 1. Assuming without admitting plaintiff's contention to be true, Fig. 4 shows merely a bar with a spiral coil attached to the bar at each convolution by a kerf inclined at an angle to the edge of the bar in such a way as to produce an overlapping integral spur, with this spur hammered down so as to hold rigidly this spiral. Defendant makes and sells a collapsible spiral used in strengthening concrete column or pillars. It consists of a cylindrical spiral of steel wire usually fitted to two bars or spacers, with each convolution of the spiral engaging the spacers at regular intervals. The engagement is so loose fitting that this construction, which is normally stove-pipe-shaped, can be made flat for shipment by moving the metal rods or spacers longitudinally in opposite directions. The method whereby

the spiral is attached to the spacer bar is a rectangular notch in the bar, with one or both corners peened or hammered down so as to retain and hold loosely the spiral. Fig. 4 and claim 3 of plaintiff's patent, it is contended, embody and cover this construction; hence the charge of infringement.

The differences in the method of attaching the spiral to the bar, the result accomplished, and the special collapsible mode of operation, between defendant's and plaintiff's construction are such that were I to adopt the limited and narrow construction given to claim 3 by the Third Circuit Court of Appeals, I might likewise dispose of this controversy by holding plaintiff's patent not to be infringed. The inclined kerf method of attachment, with an integral overlapping spur holding the spiral rigidly to the reinforcing bar or spacer, is not the exact method of attachment used by defendant. The kerfs of plaintiff's patent are required to be cut at an inclined angle to the edge of the bar, thereby creating an integral overlapping spur. This kerf and spur when hammered down, the disclosures of the patent show, were intended to and do hold the spiral rigidly or permanently in place. Defendant's spacing bars have merely a rectangular notch cut at right angles in the spacing bar, and when one or both corners are hammered down, the spiral is not held rigidly or permanently in place, but so loosely as to permit of collapsing. These differences in construction are as substantial as those held not to infringe by the Third Circuit Court of Appeals. This, however, seems to me to be too narrow a ground upon which to dispose

of this controversy. It seems to me that if plaintiff's patent is valid because novel and useful in a patentable sense, the charge of infringement could not be repelled by such an insubstantial difference in the method of attachment; particularly as plaintiff's patent suggests this method merely as a preferred method. I have therefore given careful consideration to the charge of infringement.

My conclusion is that if Fig. 4 and claim 3 disclose and cover a concrete reinforcement for columns and pillars of the character now claimed by plaintiff and as is constructed and used by defendant and others, the claim must be held void for want of patentable novelty. My reasons for this conclusion may be briefly stated.

Plaintiff's original application was filed May 8, 1906, and this must be taken as the date of his invention. True, on this hearing he offered some testimony tending to show an earlier invention date, but this testimony is not sufficient, in my opinion, according to well settled rules, to establish an earlier date. The concrete reinforcement art for columns and pillars was at this date quite well developed, although it had not come into such general and extensive use as it now enjoys. This art had been described in standard technical treatises and disclosed in numerous patents and practical constructions. Armand Considere, a French engineer, in a standard work, translated and published in New York in 1903, teaches all that can now be claimed by plaintiff for his patent or that is now done by the defendant in the matter of buildings and reinforcing concrete col-

umns, except perhaps the kerf and spur method of attaching the spiral to the spacing or reinforcing bar or bars. This is, in fact, admitted by plaintiff. Hoops, circular bands, and continuous spirals attached to spacing or reinforcing bars as a method of concrete reinforcement for columns or pillars is also disclosed by numerous patents. See Hyatt British Patent No. 1715, 1874, Pelegren French Patent No. 323,457, 1902, Considere United States Patent No. 752,523, 1904, Kieserling & Moller German Patent No. 73004, 1892. Similar constructions are also described and illustrated by Christophe in an article published in 1902, by Marquess in an article published in the Engineering News of New York in 1904, and also in other articles and illustrations in the Engineering News of March 8, 1906, and June 15, 1905.

In some the method of attaching the spiral to the bar is also disclosed. Kieserling & Moller, above noted, discloses a notch in the outer edge of the spacing bar designed to contain and hold the coils. Cummings, U. S. Letters Patent No. 822,587, application date January 6, 1905, patent date June 6, 1906, shows circular, but not spiral, reinforcing bands for a concrete column attached to the spacer bars by tongues stamped out and then pressed and hammered down over the bands. Christophe, in the article above referred to, discloses notches on the exterior faces of the spacing bars to contain and hold the spiral.

In the metal working arts, numerous patents disclose kerfs or notches, including inclined kerfs with overlapping spurs, as a means of attaching coils or

spirals to bars. See the following U. S. Letters Patent: Norwood, No. 501,575, 1896; Clark, No. 589,593, 1897; Carson, No. 278,282; McCall, No. 657,827; Caldwell, No. 682,386, 1901; Prescott & Bennett, No. 447,162, 1891; and Eason, No. 723,631, 1903. Of these patents, Norwood and Eason disclose the inclined kerf with the overlapping integral spur, and Prescott & Bennett discloses a rectangular notch or kerf cut at right angles to the edge of the bar and with the corners hammered down in the manner of defendant's construction.

Thus it appears that all the elements, both of claim 3 of plaintiff's patent and of defendant's construction, are old. Plaintiff's counsel, as already said, admits this to be true, but contends that the reinforced concrete art does not show the kerf and spur in a combination with reinforcing or spacer bar or bars and a continuous spiral, and that this novelty is of a patentable character. This claim of novelty is not true in view of Kieserling & Moller and Christophe's disclosure unless plaintiff's kerf is to be limited to a kerf inclined at such an angle to the edge of the spacer bar as to create and form an integral overlapping spur. It is the latter method only of attachment which is not plainly shown in the prior art. The numerous examples of hoops, circular bands, and continuous spirals in combination with spacing or reinforcing bars found in the concrete art do not explicitly call for an inclined kerf and integral overlapping spur method of attachment. Notches in which to seat and hold the spiral are, however, called for and disclosed. Doubtless, engineers

like Considere, Christophe, and Marquess, as well as numerous inventors, assume that any reasonably skilled mechanic or engineer would know the means used and available in the metal working art to accomplish this result, and regarded it as unnecessary to make further disclosures or to give more specific directions. Plaintiff's contention, however, now is that any kind of kerf or notch is covered by his patent, and this claim comes in conflict literally with the existing prior art.

Furthermore, invention cannot, in my opinion, be based on the adaptation of the familiar inclined kerf with an integral overlapping spur of the metal working art to its assumed new use in the concrete reinforcing art. Let it once be assumed, as plaintiff's counsel concedes, that the concrete reinforcing art teaches that the proper method of reinforcing a concrete column or pillar is to use hoops or circular bands, or continuous spirals, spaced at regular intervals around spacer or reinforcing bars and attached thereto, then the problem of making this attachment becomes no longer one peculiar to the concrete reinforcing art but belongs to the metal working art. The problem is one of the metal worker, and not of the concrete engineer. For this reason, all the means known to the latter art or used by workers therein, must be regarded as the common possession of all persons skilled in either art, and invention can not be predicated upon a transfer of a device familiar in one to a like use in the other; particularly is this true when no new principle of operation, and no new

function is accomplished or performed as a result of the transfer to the new combination.

That invention is not present under these conditions, and does not result from such an adaptation of an old device, is well settled by numerous decisions. See Huebner-Toledo Breweries Co. vs. Mathews Gravity Carrier Co. (6 C. C. A.) 253 Fed. 435; Berger Mfg. Co. vs. Trussed Concrete Steel Co. (6 C. C. A.) 257 Fed. 741; Van Dorn Iron Works Co. vs. Mathis Bros. Co. (6 C. C. A.) 260 Fed. 400, 405-6. The language of Judge Warrington in the case first cited, is equally applicable here. "It must, of course, be conceded that patentable novelty may exist in a combination of old elements; but here the combination claims in suit are lacking in the usual and essential tests of invention. No new function of elements or new method of operation is evolved, and the result achieved is exactly the same as the old one. The settled rule under such facts is that to adapt an old and familiar device to another structure equally old and well known is not to exercise the inventive faculty; it is to apply the skill of the mechanic."

Plaintiff made his alleged invention in an art already crowded and highly developed. The evidence shows that commercially he has contributed nothing whatever to the progress of reinforced concrete construction. No buildings or column were ever constructed by anyone under his patent prior to 1916. Two licenses only have been issued by him, the first in the latter part of 1916, under which no business appears to have been done except perhaps to put up one structure, and the other followed the favorable

decision in the Second Circuit. Claim 3 of his patent consequently is only another example of that class of patents described by Mr. Justice Bradley in Atlantic Works vs. Brady, 107 U. S. 192, and recently approved and re-announced by Mr. Justice Clarke in Elyria Iron & Steel Co. vs. Railway Supply Co., 242 U. S. 609, in these words: "The process of development in manufacturers creates a constant demand for new appliances, which the skill of ordinary head workmen and engineers is generally adequate to devise, and which, indeed, are the natural and proper outgrowth of such development. Each step forward prepares the way for the next, and each is usually taken by spontaneous trials and attempts in a hundred different places. To grant to a single party a monopoly of every slight advance made, except where the exercise of invention, somewhat above ordinary mechanical or engineering skill, is distinctly shown, is unjust in principle and injurious in its consequences." See also Railroad Supply Co. vs. Elyria Iron & Steel Co., 244 U. S. 285; Package Mach. Co. vs. Johnson Automatic Sealer Co. (6 C. C. A.) 246 Fed. 598, 601; A. Schrader's Son, Inc. vs. Dill Mfg. Co. (6 C. C. A.) 262 Fed. 504.

This conclusion is reached on the assumption that plaintiff's patent and claim 3 disclose what is claimed to be his invention. Personally, however, I agree also with Judge Hough's conclusion that plaintiff's invention was not what he now claims and that what is now claimed is not thereby disclosed, but that the only invention disclosed by his specifications and claims is the exact construction described and pic-

tured in Figs. 1 and 6, as to which no charge of infringement is made.

For these reasons plaintiff's bill will be dismissed at his costs.

D. C. Westenhaver,
Judge.

Cleveland, Ohio
September 23, 1920

[TITLE OF COURT AND CAUSE.]

APPEAL PETITION.

To the Honorable District Court of the United States in and for the Northern District of Ohio.

Now comes George E. Vandenburgh, plaintiff in the above entitled action and feeling himself aggrieved by the dismissal of his complaint by this Court entered on the 18th day of October, 1920, hereby prays that an appeal may be allowed to him from said decree of dismissal to the United States Circuit Court of Appeals in and for the sixth circuit and in connection with this petition herein is presented plaintiff's assignment of errors.

Your petitioner therefore prays that an order allowing said appeal be made and that an order fixing the amount of bond for costs be made upon the allowance of this appeal.

Carlos P. Griffin,
Attorney for G. E. Vandenburgh.

Appeal allowed.

D. C. WESTENHAVER,
Judge.

San Francisco, Cal.
Oct. 30, 1920

Filed Nov 5 1920 At.....o'clock.....M. B. C. MILLER, Clerk, U. S. District Court, N. D. O.

[TITLE OF COURT AND CAUSE.]

ASSIGNMENT OF ERRORS.

Now comes the plaintiff George E. Vandenburgh by his attorney and in connection with his appeal says the Honorable District Court erred as follows:

(1) In adopting "without further statement of reasons" previous decisions as to the invalidity of claim 1.

(2) In not adopting the decisions of the Courts of Appeal of the Second and Third Circuits as to the validity of claim 3.

(3) In holding that the "kerfs of plaintiff's patent are required to be cut at an inclined angle to the edge of the bar."

(4) In holding that the kerf and spur . . . were intended to and do hold the spiral rigidly or permanently in place.

(5) In holding that defendant's spiral is not held rigidly or permanently in place.

(6) In holding claim 1 void.

(7) In holding claim 3 "void for want of patentable novelty."

(8) In holding uncontradicted testimony of two witnesses insufficient to establish the date of plaintiff's original invention.

(9) In holding that combination claims are void because their several elements are old in other arts and locations.

(10) In holding that patents from the metal working arts are pertinent to concrete reinforcing.

(11) In holding that any patent in the record negatives the patentable novelty of either claims 1 or 3 and especially that Kieserling, Moller and Christophe do not do so.

(12) In holding that "Considere, Christophe or Marquess as well as numerous inventors" disclosed or showed anything which anticipates claims 1 or 3.

(13) In holding that plaintiff's claim 3 "comes in conflict literally with the existing prior art.

(14) In holding that "no new function is accomplished or performed as a result . . . of the new combination" of claim 3.

(15) In holding that "no new function of elements or new method of operation is involved, and the result achieved exactly the same as in the old one."

(16) In holding that plaintiff's inability to commercially work his invention more than he has is in any way a bar to recovery on his patent.

(17) In holding that the only invention of plaintiff is "the exact construction described and pictured in Figs. 1 and 6."

(18) In not holding claims 1 and 3 valid and infringed.

(19) In dismissing the complaint at the cost of plaintiff.

CARLOS P. GRIFFIN,
Attorney for G. E. Vandenburgh.

San Francisco, Cal.
Oct. 30, 1920.

Filed Nov 5 1920 Ar.....o'clock.....M. B. C. MILLER, Clerk, U. S. District Court, N. D. O.

(Order fixing amount of cost of bond ent. Nov. 6, 1920 by Judge Westenhaver.)

George E. Vandenburgh)
vs.) No. 500. Equity.
Truscon Steel Company)

In the above entitled cause the plaintiff having filed his petition for an order allowing an appeal together with an assignment of errors.

Now therefore upon motion of Carlos P. Griffin, solicitor for plaintiff and said appeal having been heretofore allowed from the decree dismissing the complaint in the above entitled case, it is hereby ordered that the amount of plaintiff's cost bond on said appeal be and the same is hereby fixed at the sum of $300.00.

It is further ordered that upon the giving of such a bond approved by the Court that a certified copy of the transcript of the records and proceedings herein as submitted by the parties and approved by the Court may be forthwith transmitted to said United States Circuit Court of Appeals for the sixth circuit.

UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SIXTH CIRCUIT

UNITED STATES OF AMERICA,
Sixth Judicial Circuit.—ss.

To Truscon Steel Company

Greeting:

You are hereby cited and admonished to be and appear at a session of the United States Circuit Court of Appeals for the Sixth Circuit, to be holden at the City of Cincinnati, in said Circuit on the* 1st day of January next, pursuant to a petition for appeal filed in the Clerk's office of the District Court of the United States for the Northern District of Ohio, wherein George E. Vandenburgh is appellant and you are appellee to show cause, if any there be, why the decree rendered against the said appellant as in the said petition for appeal mentioned, should not be corrected, and why speedy justice should not be done to the parties in that behalf.

Witness the Honorable Edward D. White, Chief Justice of the United States, this 2nd day of December in the year of our Lord one thousand nine hundred and twenty and of the Independence of the United States of America the one hundred and forty-fifth.

D. C. Westenhaver
Judge of the District Court.

*Not exceeding 30 days from day of signing.

Service of the above citation is hereby acknowl-

edged and appearance of Truscon Steel Co. is hereby entered.

(Seal) W. F. Guthrie
Attorney for Appellee.

Dec 7, 1920

[TITLE OF COURT AND CAUSE.]

In accordance with Section 7 of Rule 44 of the general rules of this Court, it is hereby agreed that the record as presented to the Clerk by the printer, may be certified by the Clerk as required by law and the rules of the appellate court, as a true, full and complete copy of the original pleadings, papers and orders used on the trial of this cause, as set forth in the precipe for transcript, without further comparison by the clerk.

CARLOS P. GRIFFIN,
Attorney for Plaintiff.
W. F. GUTHRIE,
Attorney for Defendant.

Filed Dec 28 1920 A.r.....o'clock.....M. B. C. MILLER, Clerk, U. S. District Court, N. D. O.

[TITLE OF COURT AND CAUSE.]

STIPULATION.

It is hereby stipulated between counsel for the parties hereto that the papers and exhibits originally filed with the District Court may be withdrawn for the purpose of printing the record on appeal therefrom, and consideration of same with a view to further stipulation for shortening the printed record on appeal after which they shall be filed with the Circuit Court of Appeals pending this appeal and that upon its determination they shall be returned to the District Court.

It is further stipulated by and between counsel for plaintiff and defendant that the printed record on appeal in the above entitled case shall consist of the following documents and none other, provided however that any document in evidence which may be omitted from pursuant to this or further stipulation may be used as a physical exhibit by either party should necessity therefore arise, all documents to be printed without extended court headings.

(1) Complaint.

(2) Answer.

(3) The actual testimony of the witnesses.

(4) The copies of patents (except Weinig 168,948, Phelps 175,155, Bauman 212,645, Monier 302,664, Stempel 411,360, Stempel 468,269, Martin 674,538, Villet 722,417, Carey 756,471, Kahn 768,284, Gardner 785,417 and Muesser 815,617) and those

parts of the other documents and printed cuts or photographs offered in evidence.

(5) Decree of dismissal.

(6) Notice of appeal and petition.

(7) Assignment of errors.

(8) Order fixing amount of bond, but which latter need not be printed.

(9) Citation on appeal.

(10) This stipulation.

(11) Any further subsequent stipulation for abbreviating the printed record.

CARLOS P. GRIFFIN,
for Plaintiff.

W. F. GUTHRIE,
for Defendant.

The foregoing stipulation is hereby approved.

D. C. WESTENHAVER.

Dec. 17, 1920.

Filed Dec 17 1920 B. C. Miller, Clerk, U. S. District Court, N. D. O.

[TITLE OF COURT AND CAUSE.]

STIPULATION

It is hereby stipulated and agreed, that the foregoing is a true transcript of said District Court in the above entitled matter as agreed on by the parties.

Dated

CARLOS P. GRIFFIN
Attorney for Appellant
W. F. GUTHRIE,
Attorney for Appellee

[TITLE OF COURT AND CAUSE.]

CLERK'S CERTIFICATE

I, B. C. Miller, Clerk of the District Court of the United States of America for the Northern District of Ohio, do hereby certify that the foregoing is a correct transcription of the record of the said District Court on the matter as agreed upon by the parties.

IN TESTIMONY WHEREOF I have caused the seal of said Court to be hereunto affixed this day of in the year of our Lord Nineteen Hundred and Twenty One.

(Sgd) B. C. MILLER
Clerk of the District Court for the Northern District of Ohio.

Proceedings in the United States Circuit Court of Appeals for the Sixth Circuit

Cause Argued and Submitted

(November 14, 1921. Before Knappen, Denison and Donahue, Circuit Judges.)

This cause is argued by Mr. Carlos P. Griffin for the Appellant and by Mr. W. F. Guthrie for the Appellee and is submitted to the Court.

Decree

(Filed January 4, 1922.)

Appeal from the District Court of the United States for the Northern District of Ohio. This cause came on to be heard on the transcript of the record from the District Court of the United States for the Northern District of Ohio and was argued by counsel.

ON CONSIDERATION WHEREOF, it is now here ordered, adjudged and decreed by this Court, that the decree of the said District Court, in this cause be and the same is hereby affirmed with costs.

Opinion

(Filed January 9, 1922.)

FILED
JAN 9 1922
ARTHUR B. MUSSMAN,
CLERK

No. 3587

UNITED STATES
CIRCUIT COURT OF APPEALS,
SIXTH CIRCUIT.

GEORGE E. VANDENBURGH, *Appellant,* vs. TRUSCON STEEL COMPANY, *Appellee.*	APPEAL from the District Court of the United States for the Northern District of Ohio.

Submitted November 14, 1921.
Decided January 4, 1922.

Before KNAPPEN, DENISON *and* DONAHUE, Circuit Judges.

KNAPPEN, Circuit Judge: Suit for infringement of claims 1 and 3 of reissued patent No. 14,182 (August 15, 1916) to Vandenburgh. The original patent,

No. 841,741, was issued January 22, 1907. The application for reissue was filed July 1, 1916. The invention relates generally to reinforced concrete construction. Its prominently-stated specific object is to "provide a reinforcing bar with one of more spirally-disposed coils secured to the bar so as to provide an extended area of contact adapted to resist strain longitudinally and laterally on the bar, and to form a truss within the body of concrete, etc." As a preferred means of securing the coils to the bar the specification discloses "a series of kerfs in one face of the bar inclined away from the center of the bar toward the opposite ends thereof," the coils being "seated within these kerfs and held therein by means of the integral spurs, which are forced downward upon the coils when inserted and permanently retain them in position." The specifications, considered in connection with the drawings, plainly show an integral spur overlapping the kerf, which when forced downward upon the coils holds them rigidly in position. Claims 1 and 3 read as follows:

"1. A concrete reinforcing consisting of a bar having a plurality of integral spurs, and a spiral coil permanently secured thereto by having the spurs bent down on the several coils, the coils extending beyond and free of the bar at the opposite side therefrom to the securing point."

"3. A reinforcing bar provided upon one edge with a series of kerfs each having an integral overlapping spur, and a coil disposed in said kerfs, each convolution thereof being retained beneath one of said spurs."

The defenses are invalidity of the reissue, lack of invention and noninfringement. The district court held claim 1 invalid as too broad, and claim 3 void for lack of patentable novelty, if construed broadly enough to embrace defendant's structure. The appeal is from a decree dismissing the bill.

The district court was plainly right in holding claim 1 invalid. As will later appear, the only novelty in plaintiff's conception is in the specific method of attaching the coils to the bar by kerfs therein and integral spurs rigidly securing the coils within the kerfs. The claims of the original patent, which were replaced by claims 1 and 2 of the reissue, in terms call for a rigid fastening. The omission of the requirement of rigidity in claims 1 and 2 was apparently intended to cover the feature of collapsibility found in later devices. Claim 1 of the reissue is thus unwarrantably broad. The same conclusion has been reached by the Circuit Courts of Appeals of both the second[1] and third[2] circuits. Claim 3 of the reissue differs from the third claim of the original patent only in the substitution in the reissue of the word "edge" for the word "end" in the original. This is plainly merely a correction of a clerical error. It thus becomes unnecessary to give further consideration to the question of the validity of the reissue.

The real date of plaintiff's invention is more or less material in determining what is prior art as related to invention. Plaintiff's original application

[1] *Vandenburgh* v. *Concrete Steel Co.*, 258 Fed., 143.
[2] *Vandenburgh* v. *Electric Welding Co.*, 263 Fed., 95.

was filed May 9, 1906. He attempted to carry the actual date of his invention back to 1903, and offered some testimony tending to show such earlier invention date. The trial judge held the testimony not sufficient to establish such earlier date. We can not disturb this conclusion. The evidence consisted solely of the oral testimony of plaintiff and another witness, taken in open court. Under well-settled rules, the burden rested heavily upon plaintiff to establish the fact of the asserted earlier date of invention to the satisfaction of the court,—whether or not such satisfaction is required to be beyond a reasonable doubt. *St. Paul Plow Works* v. *Starling*, 140 U. S., 184, 198; *Clark Co.* v. *Willimantic Co. ibid.* 481, 492; *Moline* v. *Rock Island* (C. C. A., 7), 212 Fed., 727, 732; *Barber v. Otis* (C. C. A., 2), 271 Fed., 171, 180. The question presented was one of fact only, depending upon the weight to be given this oral testimony; and the trial court's conclusion thereon must be accepted here unless the evidence decidedly preponderates against it. *Pugh* v. *Snodgrass* (C. C. A., 6), 209 Fed., 325. Assuming that we are at liberty, upon this record,[1] to consider this testimony, it is enough to say that the evidence does not preponderate against the conclusion of the trial judge.

Turning to claim 3: The art of steel-reinforced concrete construction generally was highly developed before Vandenburgh entered the field. It had

[1] The testimony is not certified as settled and approved by the trial judge, as required by General Equity Rule 75 (b). It appears to have been merely stipulated by counsel.

been applied not only to the construction of bridges, spandrel walls, dock walls, retaining walls and fireproof floor construction, but specifically to beam, girder and column construction in manufacturing and other buildings.[1] The art, generally speaking was already old and crowded, although the more extensive and rapid use of metal-reinforced concrete came a little later. Truss reinforcement of concrete beams was also old, through the use of radially disposed projections from the tension member (either perpendicularly or obliquely thereto), as well as otherwise. See *Trussed Concrete Steel Co.* v. *Goldberg* (C. C. A., 6), 222 Fed., 506, 509 *et seq.* The art with which we are here concerned relates to that form of column construction called "column hooping." While Vandenburgh's invention seems more specially adapted to beam and girder construction, it is declared by the specification to be applicable to column construction as well; and we shall treat the disclosure not only as so applicable but as intended to cover a plurality of vertical reinforcing or spacing members around and upon which steel reinforcement is wound in spiral form. Vandenburgh was not a pioneer in this field. Hyatt (by British patent, 1874), and Lee (also by British patent, in 1885) had disclosed iron bands looped spirally to reinforcing members, the spirals being riveted to each other or to the vertical reinforcement. Kiesserling (German

[1] We may refer in this connection to the following decisions of ths court: *Ferris Concrete Steel Co.* v. *Concrete Steel Co.*, 206 Fed., 666; *City of Akron* v. *Bone*, 221 Fed., 944; *Detroit Iron & Steel Co.* v. *Carey*, 236 Fed., 924; *Luten v. Whittier*, 251 Fed., 590.

patent, 1894) had disclosed columnar reinforcement by way of a series of loops attached to vertical members by square notches therein. Column hooping seems to have become active abroad about the year 1902, and in the United States about a year later; and in articles published in 1902 and 1904 column hooping was described and illustrated, the 1902 publication disclosing notches on the exterior faces of the supporting members to contain and hold the spirals. Considere (United States patent, 1904) disclosed a reinforcement consisting of longitudinal rods and "independent helicoidal coils of metal . . . surrounding the core and rods," the coils apparently not being attached to the longitudinal members; and the next year published his researches in connection with the use of "continuous helicoidal spirals." In March, 1906, the *Engineering News* published an illustrated description of metal reinforcement for columns, showing spiral reinforcement retained in place upon the vertical members between projections from the surface thereof.

It is thus apparent that Vandenburgh's invention, at the best, consisted only in the method of attaching the spiral loop to the vertical or spacing member. As already said, his method of attachment was by means of a kerf cut at an angle inclined to the edge of the vertical or spacing member, which thereby created an overhanging spur integral with the upright, the hammering down of this kerf and spur making a rigid connection between the spiral and the upright. It is true that this particular method

of attaching the loop to the upright was new as al-applied to the art of metal-reinforced concrete. But, as already shown, continuous spirals in connection with spacer bars were old in that art. It was old in metal construction generally to use that method of fastening wires to uprights, as shown by Norwood (patent, 1896) in the connection of longitudinal parallel wires with the cross-bars of sand-screens, where "diagonal slots forming acute-angle hooks" receive the wires, the hooks being "bent down to hold such wires in place." The same method had been disclosed for the fastening of fence wires to posts of cement construction, the attachment of course not being directly to the cement. We recognize that the use of diagonal kerf and overhanging spur method of connection in a non-analogous art did not anticipate the combination claim in question; but we are not considering anticipation, but invention, and the prior art in question is thus not irrelevant. *Day* v. *Mountain City Mill Co.* (C. C. A., 6), 264 Fed., 963, 964-5. The adaptation of an inclined kerf and overhanging spur connection to the reinforced concrete art amounted only to a common mechanical expedient. *Berger Mfg. Co.* v. *Trussed Steel Concrete Co.* (C. C. A., 6), 257 Fed., 741.

The defendant does not use the diagonal kerf and overhanging spur. Its coil is located in a rectangular cut in the edge of the upright, there being thus no overhanging spur, and the coil is held in position by hammering or "peening" down the metal at the edges of the rectangular cut sufficiently to hold the coil in position, not rigidly but loosely enough to permit

the collapsing of the structure for purposes of shipment. Defendant's method of fastening was also old in the metal construction art, being shown in Prescott & Bennett's 1891 sand-screen patent. The patent in suit has been considered by the Circuit Courts of Appeals of the second and third circuits. In the former (*Vandenburgh* v. *Concrete Steel Co., supra,*) claim 3 was held to disclose invention and to be infringed by a construction which seems to be substantially similar to that involved here. In the Third Circuit (*Vandenburgh* v. *Electric Welding Co., supra*) claim 3 was held limited by the prior art to a bar with kerfs in which the attached coil is placed, and a tongue or spur overlapping the kerf and holding the coil in place, and as so limited not infringed by a fastening consisting of a lip or clip struck up from the face of the spacing member.

We are not impressed that the advance in reinforced concrete construction is due in any substantial measure to Vandenburgh's contribution. Our conclusion is that, assuming for the purposes of this opinion that the claim in question involves some measure of invention, it is so narrow as to be practically limited to the specific method of fastening disclosed, and that it cannot be extended to cover defendant's method.

The decree of the district court is accordingly affirmed.

UNITED STATES CIRCUIT COURT OF APPEALS
FOR THE SIXTH CIRCUIT

I, Arthur B. Mussman, Clerk of the United States Circuit Court of Appeals for the Sixth Circuit, do hereby certify that the foregoing is a true and correct copy of the record and proceedings in the case of *George E. Vandenburgh* v. *Truscon Steel Company*, No. 3587, as the same remains upon the files and records of said United States Circuit Court of Appeals for the Sixth Circuit, and of the whole thereof.

In testimony whereof, I have hereunto subscribed my name, and affixed the seal of said Court, at the City of Cincinnati, Ohio, this 1st day of February, A. D. 1922.

ARTHUR B. MUSSMAN,

[SEAL.] *Clerk of the United States Circuit Court of Appeals for the Sixth Circuit.*

UNITED STATES OF AMERICA, *ss:*

[Seal of the Supreme Court of the United States.]

The President of the United States of America to the Honorable the Judges of the United States Circuit Court of Appeals for the Sixth Circuit, Greeting:

Being informed that there now pending before you a suit in which George E. Vandenburgh is appellant, and Truscon Steel Company is appellee, No. 3587, which suit was removed into the said Circuit Court of Appeals by virtue of an appeal from the District Court of the United States for the Northern District of Ohio, and we, being willing for certain reasons that the said cause and the record and proceedings therein should be certified by the said Circuit Court of Appeals and removed into the Supreme Court of the United States, Do hereby command you that you send without delay to the said Supreme Court, as aforesaid, the record and proceedings in said cause, so that the said Supreme Court may act thereon as of right and according to law ought to be done.

Witness the Honorable William H. Taft, Chief Justice of the United States, the sixth day of April, in the year of our Lord one thousand nine hundred and twenty-two.

WM. R. STANSBURY,
Clerk of the Supreme Court of the United States.

United States Circuit Court of Appeals for the Sixth Circuit, *ss.*

In pursuance of the command of the within writ of certiorari, I, Arthur B. Mussman, Clerk of the United States Circuit Court of Appeals for the Sixth Circuit, do herewith transmit under the seal of said court, a full, true and complete copy of the record and proceedings of said court in the cause and matter in said writ of certiorari stated, to the Supreme Court of the United States, together with the said writ.

Witness my official signature and the seal of said court at Cincinnati, Ohio, in said Circuit, this 28th day of April, A. D. 1922 and in the 146th year of the Independence of the United States of America.

[Seal of the United States Circuit Court of Appeals, Sixth Circuit.]

ARTHUR B. MUSSMAN,
Clerk U. S. Circuit Court of Appeals.

[Endorsed:] 3587. (C. C. A.). File No. 28,719. Supreme Court of the United States, October Term, 1921. No. 764. George E. Vandenburgh vs. Truscon Steel Company. Writ of Certiorari. Filed Apr. 17, 1922. Arthur B. Mussman, Clerk.